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EDITORIAL NOTES.

Toluol and Statutory Obligations—The Case of the Small Works.

INDICATION was given in our editorial columns last week that affairs were developing in connection with the process for the recovery of toluol by gas-washing; and it may now be taken for granted that the further step has been definitely decided upon with the view of increasing the supply. Associated with this is the important question as to the position of gas undertakings which, by reason of compliance with the requirements, may infringe their statutory obligations. There is satisfactory answer. Any undertaking the gas supply of which is reduced below standard quality owing to the work that it is doing for the Ministry of Munitions will not incur any penalty through failure to comply with the statutory prescriptions; these being over-ridden by the Defence of the Realm Act. Beyond this it may be stated that everything is being done, and will we understand be done, to defend gas undertakings from any attempts that may be made to disparage them and their supply through consequences arising from what they are doing for the Government, and, through the Government, for the country. This intimation will allay any uneasiness on that score.

One result of the articles that have recently appeared in our columns on the subject of working for the maximum possible supply of toluol, has been certain communications from small undertakings. Among them is one which puts to us a number of questions bearing upon the matter. It must be confessed that we were somewhat astonished to receive the inquiries; and, although in last week's issue it was intimated that there was no occasion to make public reference to them, perhaps after all an answer will be of more than individual service. The writer—and he a gas engineer—sought, in the first place, information as to the size of small works that could reasonably be expected to put the "C" process into operation. There is not the slightest necessity to define the minimum size of works that can adopt the process. It is not the size that is important, but the conditions. In this terrible war, great and united effort has to be made, and heavy sacrifices incurred. But it is not, in this particular matter, a heavy sacrifice that is being sought from either large or small gas-works. And the reply that best fits the foregoing question is that a man in charge, or having control, of a gas-works who says it is too small to help in the supply of toluol should be placed in the same category as the military fit man who offers the excuse that he will not, or that there is no occasion for him to, join the Army because he is only one man out of 3 millions. The Army of which the nation is so proud is made up of individuals; the total quantity of coal the gas industry carbonizes is made up of tons, hundredweights, or pounds; the total amount of toluol required in this war is made up of gallons. The contribution of any gas-works will raise the value of the total. Every gallon brought into the common stock, every shell that can be produced as the result, every mine and every bomb that is charged, make the country's position the stronger and the more secure. In this matter nothing is negligible.

Another question put to us by the correspondent is as to the cost of the plant necessary to work the "C" process. The cost of the plant naturally depends upon the quantity of work to be done; and no gas engineer would find it necessary to ask this question if he had made himself acquainted with the process, as could have been done by the study of the circulars sent to every gas undertaking in May last by the High Explosives Department. With before him the information contained in these circulars, any gas engineer could estimate for himself the cost. But the very purpose of the "C" process was to provide a method of treating gas that would only require the simplest of plant, and plant that is already available on most gas-works. A good deal of ingenuity has been shown in connection with the provision of plant for the process; even discarded plant has been reintroduced to carry it out. Some of the small works that are now doing their best had not the necessary spare plant, or had only part. The deficiency in some cases may have been a pump or a scrubber. And it has been gratifying to witness how, without any ado, and without reference to anybody, the deficiency has in most cases been made good, as plant of the kind will come in useful in normal times as expansion or replacement necessitates. Of course, in the smallest of works which have not the requisite spare plant, and from which, if the process were adopted, only a comparatively small increase of toluol per annum would be obtained, it might not be worth while buying new plant. But, speaking generally of works, in not a few instances, the extra return received from tar as a result of its enrichment through the process has compensated for the initial cost. The managements of gas-works who send their crude treated tar to the tar distillers should see that they get the increased value for it. The Government have a fixed price which they pay for toluol; but we are sorry to say our information goes to show that not all tar distillers are "playing the "game" in their dealings in this particular respect with gas undertakings.

The next question with which we have to deal seems to contain a veiled suggestion that the High Explosives Department favour some gas-works, and not others, in the way of initial assistance. Knowing what we do, we are rather sorry to see this. The question was, "Does the Govern- "ment supply the plant, or is it left to the patriotic tendency "of some; while some favoured works receive Government "assistance?" Most gas undertakings, if they have not the plant at liberty for the process, have made no bother about the matter. The call came; the ability to respond was there; and there was hearty response. In only a comparatively few cases has any financial assistance been rendered. And in them a grant has only been made after complete satisfaction that the claim is a reasonable one. But let us put the matter into figures. There are to-day some 600 gas-works with the washing process already at work; there will be more shortly, but the number falls very far below the total gas-works in existence in the United Kingdom. Of the 600, not more than twenty have asked for financial assistance. This speaks well for the simplicity of the process; it speaks loudly too of the patriotic feeling that has prompted ready compliance. We would rather be one of the 580, than one of the twenty. Every one of the twenty cases has had to be considered on its merits; and not all of the applicants for a grant have been successful. The sole factor, we believe, that has guided the department has been the increased amount of toluol that is likely to be obtained for the money spent, because naturally there is a limit to the price that even the country can afford to pay for toluol. Where assistance has been rendered, it has only been a percentage of the total outlay. These facts will show that any insinuation as to favouritism in financial aid may be dismissed as having no foundation. It is a matter of extreme gratification to know that such a small number of the gas undertakings with the process in operation have even sought financial help.

There were two other questions put by our correspondent. The first one is answered in the important announcement made in the opening paragraph of this article. The other one was, Where can particulars of the "C" process be obtained? Are we to understand by the inquiry that this gas engineer has not seen the circulars sent to gas-works in May last? Are we to understand that he has never been to any one of the several private meetings of gas engineers at which the "C" process has been discussed? Are we to understand too that the gas-works in which he is interested have never been visited by an Inspector—one of the several gas engineers who are voluntarily and patriotically

devoting time to this work? We really cannot bring ourselves seriously to believe that any gas engineer in this country has not heard of the "C" process, and does not know its details. A paragraph was read the other day in which it was stated that a man had been discovered in a very rural quarter of the country who had not heard that so great a part of the world was engaged in war. But we had no notion a British gas engineer could be discovered who to-day did not know the details of the "C" process. There is no intention of enlightening him here; but there is not the slightest doubt that the High Explosives Department would be pleased to take the case in hand, and supply the knowledge which was in the possession of other gas engineers six months ago.

We reiterate what has been said in a previous article, that those who have the power to help in any way and in any degree to produce victory, and do not perform their part to the full are enemies to their country. Victory is the first interest to-day of every true patriot.

A Chemical Intelligence Department.

THE Board of Trade will be glad when peace again reigns, and when the men who have schemes for raising the prosperity of the country to a high altitude have subsided to their former state—at any rate, this is so of those whose schemes bear facial evidence that their authors' ideas and ideals have not about them an essentially sound practicability. Since the war began, the Board of Trade have been proposed as the dumping-ground of all sorts of measures associated with the expansion of industry and trade, and the bagging of the commerce of the enemy; and, despite the past reputation of this much overloaded Government Department, another project has been propounded for its acceptance. This has emanated from the brain of Dr. M. O. Forster; and he first put it forward at the annual meeting of the Society of Chemical Industry, and last week introduced it for the consideration of the London Section of the Society, on which occasion there was a very manifest division of opinion upon it, though courtesy allowed no actual hostility. What he wishes is that a Chemical Intelligence Branch of the Board of Trade should be established. An "intelligence" branch associated with anything is about the last class of work that, in addition to what they have already in hand, the Board should be asked to take up; for it is common experience that the functions of the Department in this regard are generally so exercised, that there is a remoteness between the data and the time of availability through which a large part of their usefulness is lost.

There is by no means opposition on our part to the organization of any system which will assist any industry by the collection, co-ordination, and circulation of information. But the whole success of such a scheme depends on the rapidity with which the work is achieved, and reliable results are placed at disposal. It seems to us that the chemical industry is wealthy enough to have an organization of its own, with commercial agencies in all parts of the world, to supply it with information, and that this could be done with greater genuine result, and better control, than if the matter was placed in charge of the Board of Trade, and the data subjected to the ordinary routine, and secreted away till such time as red-tape permitted their disclosure. But it appears that Dr. Forster thinks that neither the general public nor the Government fully appreciates the chemical industry, nor does enough for it; and this fact has put it at a disadvantage when compared with Germany. The chemical industry of this country is actually one of the wealthiest of all the industries; and it ought to have been quite capable of looking after its own interests, and not have allowed things to come to the pass portrayed. Unless some definite steps were taken, Dr. Forster said, to establish chemistry on such a footing that it could assume its proper place in the national economy, the restoration of European peace would be a signal for the restoration of British chemistry to its former ignominy. Whose fault is it that British chemistry has not hitherto assumed its proper place in the national economy, and whose fault will it be if after the war it sinks back into a secondary position compared with Germany? We are all prone to look after ourselves; that is only human nature, though some are disposed to do so to a point that falls within the region of a slavish selfishness. Those of the chemical industry who think the Board of Trade should take the industry under its wing, and act as intelligence collectors and circulators for its benefit as much as for that of the "national economy," should explain why such preferential consideration should be showered on it, and not on other industries that are equally worthy, if not so opulent.

The scheme of work that Dr. Forster suggests should be taken in hand by the Board is of an extensive character, as will be seen by the report in another column. Some of the officials of the Board of Trade have no doubt been interested in it, have smiled over it, and have consigned it to a place where it will no further trouble their minds. The machinery that would be wanted to give effect to the scheme as roughly drafted would be of a remarkably complex character; and complex machinery frequently gets out of order, and does not run with the perpetual smoothness that is desirable. Consideration of this in relation to Dr. Forster's estimate of the cost shows how he fails in practicability—for his estimate of annual expense is out of all proportion to the vastness of the work that he would like to be undertaken. His computed £5000 would soon be expended. But if this were all the expense required for such a great work, then the chemical industry ought to be ashamed of itself for not undertaking it on its own account—organizing it properly, and reaping the benefits at as early a date as possible. Dr. Forster, if he wants to see his scheme develop, had better turn his eyes away from Whitehall to the direction in which chief interest in the matter lies.

Government Reciprocity.

THE Government have in connection with the war established several new departments and appointed various Committees to look after special work. With the mass of work entailed by the great upheaval, devolution was unavoidable. But now the Government ought to appoint another Committee charged with the duty of seeing that what is done by one department is not detrimental to, but if anything facilitates, the work of the others. The conditions now existing between the Government and the gas industry are absurdly antagonistic. The Government ask much of the industry; but they will not give it the wherewithal to increase its capacity for meeting their requirements, nor do they set a good example. The gas industry, in one sense, is worse off than the children of Israel when they were given no straw with which to make bricks, for they were allowed to go and gather straw on their own account, although they had to produce the same tale of bricks. The industry is not even permitted to gather for itself what is requisite (and yet the Government will not supply it) to do the best possible to meet the country's needs. This was pointedly shown by the letter from Mr. W. M. Mason in last week's "JOURNAL," giving an account of the case that was laid (it was tantamount to a protest) by the deputation before Sir Sothern Holland, who represented Lord Moulton, at the Ministry of Munitions. The deputation was composed of Mr. John Young, President of the Institution of Gas Engineers, and Mr. W. E. Price, Hon. Secretary; Alderman F. Templer Depree, Chairman of the Council of the Society of British Gas Industries, and Mr. F. W. Goodenough, Chairman of the Executive Committee of the British Commercial Gas Association. Alderman Depree, by the way, at the meeting of the Society of British Gas Industries, referred to the matter, and expressed the hope that the anomalous conditions would not be allowed to rest without still further effort to get them into something like order, so as to make them helpful the one to the other, instead of their being continuously hostile.

The Government say: "This is a war of high explosives; "and the gas industry must give us more and more of the "essentials with which to make them." A Committee appointed by the Government urge the public to consume more gas and coke instead of coal, in order to increase the supply of gas from which toluol and other valuable constituents can be extracted. But the departments that are asking for more explosives, and the one that urges the public to use more gas, find that their efforts in this direction are rendered partly ineffective by other departments withholding sanctions to capital-raising and loans for the extensions of gas plant and the provision of appliances through which gas is consumed. Increases of consumption cannot be met if there is not the extra producing and distributing plant available; and consumption cannot be enlarged without there are the appliances to be let out on hire to the public. Other conditions that are difficult to reconcile are that the War Savings Committee urge people to use gas and coke, in order to save coal, and

help to provide more gas which can be washed for the recovery of the valuable constituents for war purposes, while the Government do not set them the example. There are numerous Government buildings in which gas instead of coal could be used for heating and coke for hot water supply; and, in connection with many of the new premises connected with the training of the Army, there is larger scope for the employment of gas than is now the case. Custom and electrical influence in certain Government departments are probably responsible for this last-mentioned state of things.

But there is the absurdity of the contrary conditions—the asking for more explosives, and urging people to use additional gas, while capital is being withheld from the industry and the Government themselves, in the public buildings, are not practising as largely as possible what one of their Committees have been preaching. There must be economy in labour in order to raise the producing efficiency of the country, and in order to release as many men as possible for the Army and Navy and munitions work, and women for such work as comes within the limits of their capacity. The use of gas in the industries producing munitions has lowered the requirement for labour in proportion to output, and the extension of gas for domestic purposes has diminished labour in the home—thus increasing the country's available labour. With all this, facility and encouragement for the industry are denied by the existence of opposing conditions, by jealousy of departments, and by unwillingness to make exceptions to rules when exceptions are palpably justified. Distribution of work may be most essential in the Government departments; but so is system over all of them, if the utmost good is to ensue for the purpose upon which zeal and desire are bent throughout the nation. System and co-ordination cannot be realized while things are as now.

Scientific and Industrial Research.

In our "Correspondence" columns, there appears a letter from Professor W. A. Bone, F.R.S., treating of the proposal to establish a permanent State-aided organization for the promotion of scientific research, with a view to its application to trade or industry. In this communication, the writer appears in the dual *rôle* of friendly critic and adviser. No one can challenge his competence to adopt this dual *rôle*, in view of his personal work as a scientist and investigator, and his experience in developing invention with the object of its application to industry. The State aided scheme has his blessing; but the advice which he tenders in his letter may be taken as a warning that, if the scheme is not organized and developed on lines which will promote the most efficient results, and give encouragement and protection to the country and to individuals, it will fall short in it potentiality for good, and may inure to the material advantage of foreign countries, and, to the extent that it does so, to the detriment of our own in limiting the financial benefits that it should realize from its own brains and enterprise. This has to be guarded against. The letter gives us what Professor Bone conceives to be the correct lines upon which the scheme should be organized. There are various points in, and touching upon, the communication to which we will take another opportunity of drawing attention, and which we have not the opportunity of dealing with on the present occasion. The subject is one of such importance to the future well-being and development of British industries that it should receive the careful consideration of every person who takes an intelligent interest in the progress of home prosperity. We are incurring an indebtedness to-day which makes the highest possible promotion of the national prosperity an essential matter; and the efficiency of any scheme to this end will depend upon the manner of its establishment, and the lines upon which it is conducted and worked. This being so, considered views such as those that Professor Bone advances should be very valuable, and help those chiefly concerned in the matter to propound the details of a scheme worthy of the country and of the beneficial object.

Intensive Cultivation—National and Agricultural.

There has been a perfect deluge of oratory and writing on what must be done to make the most of our position nationally during and after the war. We are building-up for ourselves as a nation a tremendous load of debt on account of the work now in hand; and we have not only to prepare for the liquidation of this debt, but to secure and develop our industrial and commercial position. Intensive cultivation is a short expression for the application of scientific methods to agriculture with the view of increasing the yield of the land. It is a convenient expression in connection with the subject in hand. The road to making this nation more prosperous, and so enable it to the more readily liquidate the heavy load of accumulating debt, and to consolidate the country's industrial and commercial position, it is generally conceded is by intensive cultivation—in other words, by bringing about a closer union in all industries between scientific and theoretical learning and practical experience. Dr. J. A. Fleming has, in a lecture at University College, been dilating on the (especially lately) well-advocated method. He has pointed out that there are no short cuts to national efficiency or to scientific pre-eminence; but it should be the concern of all to bring scientific methods to bear upon the affairs of the nation. But though we are all persuaded that the truth of this matter is as firmly established as any scientific truth, yet we pursue the old custom of not going seriously and expeditiously to work in order to produce reformation. This is not what is now required. Procrastination will serve the enemy better than it will us nationally. So Dr. Fleming urges that proper steps should be taken to thoroughly organize scientific and inventive ability, and bring about its better application in industrial work. But this will never be thoroughly, but only sporadically, done, unless the industries of the country are themselves first organized with the specific view of bringing about this closer union and aid.

There must, however, be great care in the selection of suitable aid in working with the view of realizing the intensive cultivation of national prosperity. For instance, it would hardly do for the home gas industry or the coke-oven industry, or for the matter of that the nation itself, to seek Dr. Fleming's aid in advancing their interests in the artificial fertilizer field. In the course of his lecture, he remarked:

> Another question is the use of coal as a means of producing the electric energy necessary to oxidize atmospheric nitrogen, and so produce fertilizing compounds. We have to adopt more largely intensive cultivation of the soil for food production, and we must produce the nitrates and ammonia salts necessary for fertilizers out of our own atmosphere and water, and by aid of our own coal, and not purchase them from outside, or let other nations make them for us.

We have recently been counselled by another eminent Professor not to waste coal in industry, but to make the most out of it in order to advance the economic interests of the nation. The burning of coal under steam-boilers only to produce electric energy is a process wasteful of many valuable constituents—among them the nitrogen from which sulphate of ammonia (the best of all artificial fertilizers) is made. Dr. Fleming, it appears, would continue to permit this waste, in order to obtain electric energy with which to oxidize atmospheric nitrogen, while he might go to work in a more scientific way, by carbonizing the coal, so producing gas for the generation of the electric energy, and at the same time rescue the other valuable ingredients of the coal. He writes as though our artificial fertilizers are all purchased from abroad. This is unkind. From 16 million tons of coal used in the gas industry, from an almost equal tonnage of coal used in the bye-product coking industry and in producer gas plants, not omitting the yield of the shale-oil industry, there is an output of sulphate of ammonia which so far exceeds the demands of this country that many, many thousands of tons have to cross the seas to find absorption in other markets. Perhaps we have not correctly interpreted the remarks of Dr. Fleming as quoted above. If so, then ambiguity of his own making must be responsible for our want of appreciation of his intentions.

Architects and the Service of Gas.

A large amount of valuable work has been done among the medical profession in connection with the uses of gas; until now probably four-fifths of the faculty in London employ gas-fires in their own houses for heating, to say nothing of the other purposes to which gas is applied by practically every one of the members of the profession. They were not altogether blameworthy for their past attitude towards gas heating; the primitive types of gas-fires were enough, with their desiccating effect upon the atmosphere, their emanations of products of combustion, and their low radiant efficiency, to make an enemy of every medical man. But that is now completely and permanently changed; and there are, and have been for some time, thousands of medical

converts to gas heating. Architects, too, are to-day much more friendly than they formerly were; and the conventional provision for coal-grates and coal-heated kitcheners and water-circulating boilers has undergone considerable change. The gas-stove maker is now frequently in collaboration with the architect, who must to-day, to meet the views and wishes of his clients, be as well acquainted with the gas-stove makers' show-rooms and goods as he is with those of firms who specialize in coal ranges and grates. But there is still much work to be done among architects —work of a technical and generally informative character. It is a sign of growing interest and recognition when one sees that the architectural and building journals are devoting space to treating of the place gas occupies in the modern household conveniences, and advocating the modifying of architectural features and plans, so that rooms are arranged for gas heating, with flues of the restricted area that is sufficient for the products of combustion and for ventilating purposes, and so saving space and expense in this way, as well as by not having to provide coal-grates. Architects, too, are not so indifferent as they were at one time respecting the provision of accommodation for gas-heated ranges in kitchens, as well as for gas or coke heated boilers. Architectural progress includes consideration for the advances in domestic convenience, comfort, and labour-saving; and no architect can to-day afford to be behind the times in these matters.

Our attention has been again directed to this matter by references in the annual reports of the British Commercial Gas Association and the American Gas Institute. In the report of the former, it is stated that a book is in preparation, on the uses of gas, for the information of consumers, and especially of architects. This appears to us to be a peculiar combination. It seems hardly possible that a book which appeals to ordinary consumers will be exactly the sort of thing that will be most useful to architects. A book prepared for the former would hardly go far enough for the latter; and what would be requisite for the latter would naturally deal with important technical details which would repel rather than draw the ordinary consumer. We hope the value of the Association's book is not going to be spoilt for both the ordinary consumer and the architect by trying to make it fit distinctive purposes. It seems to us that the preparation of a book suitable for the architectural profession should be a matter for the Institution of Gas Engineers. The American Gas Institute thinks that it is their business; and, from their last report, it was seen that their scheme for a volume for the information and guidance of architects and builders is of very comprehensive character. If the plan is consummated, the Committee who have the matter in hand will produce something that will be really worth having by architects, as well as of value to the gas industry.

It is contemplated that information shall be given in it as to the supply, standard, and character of gas service, including information as to qualities and necessary quantities. Then piping, specifications, &c., will be treated upon. Following, the uses of gas in the home and for industry will be explained in good detail; and then there will be description of appliances to be used for lighting, heating, and power. The advantages of gas as the agent for these purposes will be put forward—economy, flexibility, artistic considerations, reliability. Then there is to be guidance as to the size of units essential under certain representative conditions. Hygienic value, quality of light, effect of lighting agents upon the eyesight, the safety of gas, the aid that it is to ventilation, and the effect of the use of gas upon the chemical constitution of the atmosphere are to have place in the composition. There is also to be all sorts of information as to the use of gas as a fuel for domestic and industrial purposes, including power. Any book that falls short of this plan will be lacking in information that should be put into the hands of the architect. If it was not contemplated that the book the British Commercial Association have in hand should come up to the American project, then it would be a good thing for revision to take place, so as to co-equal the information, if not to carry it somewhat further. Of course, the synopsis of the contents of the American book does not indicate the details; but the usefulness of gas in assisting in the reformation of certain architectural details is also a matter that should be embraced.

It is a coincidence that the two reports referred to should have simultaneously drawn attention to the question of providing information for architects in connection with gas utilization; but the fact shows that on both sides of the Atlantic the matter is regarded as highly important, and as calling for consideration and action. It is so important that we hope it will receive adequate and thorough treatment. Work of the kind that is worth doing at all is worth doing well.

Trade Marks and the Enemy.

Before the Society of British Gas Industries, last Thursday Mr. R. J. Milbourne brought the subject of "War and British Trade;" and one outcome of this was that much was heard as to the underhanded methods of German traders, behind which methods they laugh at the rules and regulations of British authority, and quietly pocket the proceeds of their craftiness. There was ample evidence forthcoming that goods made in Germany, or in neutral countries with German capital, reach this country with fictitious trade marks upon them, or otherwise labelled with falsehood as to the land of their birth. There was passed round the room a box of mantles labelled "British made." The label covered one bearing the name of a firm and an address in Berlin. This flouting of British authority is proceeding under the very noses of those who ought to detect this commercial *ruse de guerre;* it is going on while the country is at war, and when the country and its manufacturers ought to be protected from the trading wiles of the enemy in a more effective way. If this sort of thing can now exist, one cannot look very hopefully on the position when what Mr. Milbourne referred to as that great economic struggle is upon us that is going to take place after the war. In the comparatively simple matter of trade marks, the Government ought to see that the home buyer and manufacturer are defended against counterfeit and public deceiving presentments of the genuine thing. But they do not appear to be prepared or very anxious to take up the matter. Through the Board of Trade, the movement of some short time since for an Empire trade mark for the protection of this country and our Colonies ended abortively. There seem to be a good many flaws in connection with this particular matter, and there is no sign of any attempt at rectification. It was suggested at the meeting that there ought to be a full investigation into the use of fictitious trade marks and pseudo-descriptions. That is so; but British manufacturers must combine to bring their full weight to bear upon the Board of Trade, or, following precedent, nothing will be done.

Gas Undertakings and Foreign Made Goods.

Of course, as was pointed out by one speaker at the meeting, it will rest very much with the buyers whether, after the war, they will assist the manufacturers at home, or those of Germany to re-establish their commercial opulence here. There are gas undertakings to-day that are patronizing the enemy under spurious designations and stampings; but there are also gas undertakings that will have nothing to do with any articles the origin of which is suspect. There are patriotic, as well as unpatriotic gas undertakings. They cannot all be placed in the same category. Members of the Society, however, see in show-rooms of certain gas undertakings, lamps, mantles, and glassware that they know are not "British made"—lamps that bear all the evidence of their Teutonic origin, and mantles that they know have travelled *viâ* a neutral country before being landed on British soil. The glassware we are not so surprised at, owing to the incompetence of this country to cope at present with the full demand, and the fact that some of the American production that has been tried is not all that is desirable, especially in the matter of heat resistance. In a time of famine, one does not feel disposed to turn from the door the very thing for which there is dire need. Anyway, the members of the Society of British Gas Industries do not regard the purchase to-day by gas undertakings of goods bearing evidence of German origin as either creditable or patriotic.

Protection Wanted.

There is another point, and not a very pleasant one; but there must be allusion to it. A majority of the members of the Society contribute to the funds of the British Commercial Gas Association; and they are urged to contribute more. The object of the Association is the expansion and consolidation of the British gas industry generally, which does not include the expansion, now or hereafter, of the trading enterprise of enemy

countries. It is stated that it is known that even some of those representing gas undertakings subscribing to the British Commercial Association have been—some are still so—purchasers of foreign-made goods of types which, of equal quality, but perhaps of moderately higher prices, are produced in this country. This is not encouraging to certain of the manufacturers contributing to the Association; and they will next have to subscribe among themselves towards a fund for carrying on a campaign among gas undertakings that are not all-British in their dealings. At the meeting last Thursday, Mr. Fred. J. West drew attention to a resolution passed by the Manchester City Council to the effect that no contract shall be entered into with any person of German or Austrian nationality, and that no contract shall be entered into with any firm or company whose subscribed capital (whether by way of shares or otherwise) is held or controlled to the extent of one-third or upwards by persons of German or Austrian nationality. This is a sweeping resolution; but the Manchester Corporation are by it setting an excellent example to the citizens. In connection with gas undertakings, Mr. West would like to see a provision inserted in the standard contract clauses to the effect that all goods or parts under the contract shall be British made. Patriotic gas undertakings ought to have no objection to this. He also thought it should be possible to draw up some agreement with regard to dealings with concerns in which German capital exists. All the views expressed found acceptance among the members; and it will be interesting to watch for the upshot if the Council of the Society decide to enter into communication on the subject with the Council of the Institution. There is one thing certain, which is that those controlling the gas industry of the country must, if they are wholly patriotic, see to it that, neither now nor in future, they do anything that is avoidable to contribute to the wealth of countries that are now our enemies.

Reservation and Price of Sulphate of Ammonia.

A circular-letter of considerable importance has been sent out by Mr. D. Milne Watson, the Chairman of the Sulphate of Ammonia Association, regarding the question of the quantities of sulphate of ammonia to be reserved for home use, and the prices to be charged. There has had to be some modification of the original agreement in reference both to quantity and price; and on these points the letter gives full particulars, as well as in relation to other details upon which makers will desire to be informed. An interesting matter is that the Board of Agriculture have decided to send out a pamphlet recommending farmers to use sulphate of ammonia on autumn wheat. This act will hold advantage for the future home use of sulphate of ammonia. Further, as reduction of imports and increase of exports generally are among the lines of financial improvement for the country, the less nitrate of soda the country imports the better.

Gas as a Case-Hardening Agent.

The second paper which Professor A. H. White and Mr. Homer T. Hood presented at the meeting of the Michigan Gas Association dealt with the subject of gas as a case-hardening agent; and it will be found as practical and valuable as the one on the heat treatment of iron and steel in a neutral atmosphere. From the paper (the text of which is given in other columns), one learns why coal gas or carburetted water gas is pre-eminent among carburizing agents in the process of case-hardening. Not a few readers know anything more about the process than is divulged by the descriptive term. The paper will enlighten them. It also discloses why solid carburizers are not so good as gaseous ones. The action of the former is due primarily to the gases they evolve; and therefore it is easily understood that there will be depreciation of activity as emission of the gases declines. With a suitable gaseous carburizer, uniformity is assured. The authors discuss the use of carbon monoxide, hydrocarbons, and and cyanogen as carburizing agents; and from the discussion one is led to see why coal gas or carburetted water gas is *par excellence* the carburizing agent. Carbon monoxide, used alone gives a case low in carbon, and so it is a poor carburizer. Hydrocarbons are much stronger; methane being the most stable. Carbon monoxide, giving a gas low in carbon, works better if enriched with a more active carburizer. Thus a mixture of carbon monoxide and hydrocarbons gives the best results. Cyanogen carburizes very energetically; but it produces a case which is high in carbon, with an abrupt change between the carburized part and the central core, which is not carburized.

Why Town Gas Excels.

Of course, the advantages of town gas in case-hardening operations have been recognized for a long time now; hence its adoption. Efficiency, equality, and controllability have placed it in the forefront for the purpose; and its application is growing fast. The results have not, in the hands of some operators, always been all that could be desired; but the consistent high-level results achieved by others have proved applicability, and have gained for the process large adoption. Apart from controllability, the valuable effect produced by the use of town gas as a carburizing agent is due to this: When the gas is introduced in a slow stream into the carburizing retort, it breaks down—the hydrocarbons changing to free carbon and hydrogen, and the carbon dioxide and water vapour present react, forming carbon monoxide and hydrogen. The results of the experiments show how the rate at which the gas is conducted through the apparatus affects the carburizing. A practical operating rule is that the gas should be run into the carburizing chamber at such a rate that there will be a light deposit of carbon on the iron being carburized. If an attempt is made to carburize rapidly at high temperature with coal gas or carburetted water gas, a too hard and sharply marked case results. But case-hardening at a high temperature for a relatively short time, and then turning-off the carburizing gas, and allowing the hot metal to soak in the furnace, will cause diffusion of the carbon towards the interior, and so any desired type of case can be obtained. To both the gas and metallurgical industries, studies such as this of Professor White and his collaborator are of considerable importance.

PERSONAL.

Mr. WILLIAM RUSSELL, who has been Assistant Gas Manager at Grangemouth for the last two years, has been appointed Gas Manager at Kincardine-on-Forth.

Among current staff changes in connection with the Gas Light and Coke Company, it is announced that Mr. C. G. LANGFORD has been appointed an Assistant Engineer.

Sub-Lieutenant F. WATKINSON, son of the late Mr. J. G. Watkinson, proprietor of the firm of Messrs. J. & W. B. Smith, of Farringdon Road, E.C., has been promoted to Lieutenant. The firm have now 31 of their men serving with the Colours.

The Keith Gaslight Company have appointed Mr. JAMES BOECHER, of Aberfeldy, as Gas Manager in the room of Mr. John Cay, who resigned after 27 years' service. Mr. Boecher was previously in the employ of the Kirriemuir Gas Company.

On the outbreak of war, the Editor of the "Croydon Co-Partner," Mr. W. H. TOPLEY, joined his regiment, the East Kent Yeomanry; and he has since obtained a Commission in the 12th County of London, where he acts as Transport Officer.

Mr. JOHN HUNTER, Managing-Director of Sir William Arrol and Co., Limited, has resigned his seat on the Board of the Company, and has accepted the invitation of the Minister of Munitions to become Director of Factory Construction in connection with the national projectile factories now being erected in various parts of the country.

Members of the gas profession throughout the country will be pleased to learn that Mr. W. DOIG GIBB, M.Inst., C.E., after his rest from professional duties, is now devoting part of his time to work for the country. It was felt that his technical knowledge would be of considerable assistance to those who have been labouring so assiduously, and with such good effect, in the High Explosives Department of the Ministry of Munitions, and that, with such a well-known member of the gas profession there, the cordial relations which have been so quickly established between the department and most gas undertakings would be still further strengthened. Mr. Gibb has undertaken to devote a number of days each month to the work of the department, so as to leave the remaining days entirely free to devote to his own consulting gas practice.

On relinquishing his position as Engineer of the Nechells works of the Birmingham Corporation Gas Department, so as to become Chemical Engineer to British Dyes, Limited, Dr. W. B. DAVIDSON was presented with a silver tea and coffee service, with a salver, which was inscribed: "Presented to Dr. W. B. Davidson by the staft and workmen of the Corporation Gas Department, Birmingham, on his resignation as Engineer of the Nechells works, August, 1915." In making the presentation, Captain R. S. Hilton (the Secretary and Manager of the Gas Department) said he hoped Dr. Davidson would look upon the gifts as a reminder of his connection with the Gas Department. They trusted he would attain to higher distinction in the chemical world. His ability ensured for him a great name. In the course of his reply, Dr. Davidson expressed his regret at leaving the Nechells works.

ELECTRICITY SUPPLY MEMORANDA.

THE men of the electrical industry, we know, are keeping sharp observation upon the gas industry at the present time. It is stated that some of our electrical friends are rather envious of the position that the gas industry has taken in connection with the war. The industry has proved an invaluable asset to the nation; and without its help the enemy might have overrun Europe, and the consequences would have been extremely unpleasant for the British Isles. Germany at the beginning of the war had what this country had not got—an abundant supply of high explosives; and the British gas industry came to the rescue of the homeland by setting to work to recover benzene and toluene so as to repair the neglect of the past in the matter of the storage of the essentials for, and the provision of, high explosives. Picric acid was required from tar to serve as the base for lyddite, melanite, &c. Sulphuric acid was also required in large quantity; so was carbolic acid. There is definite information that the gas industry is to be called upon to do still more in this line. In another direction, some gas undertakings in large industrial areas are operating under extraordinary conditions through the supply of light, heat, and power for the manufacture of munitions. We have reported that at Birmingham the consumption of gas in the last six months was 13¼ per cent. greater than during the corresponding six months, owing to, as Sir Hallewell Rogers says, almost every Government contractor for munitions employing gas for lighting, heating, or power, or for one or more of these purposes. The metallurgical industries, for example, are in some places working double shifts. Such a condition was unforeseen; and the Gas Committee of Birmingham have, pending the installation of additional carbonizing plant, had to ask consumers to economize their gas consumption during the coming winter months; and this notwithstanding reduced street and shop lighting. This big rush for gas has occurred not only in Birmingham, but in other great industrial centres; and this simultaneously with the enormous reduction of gas-works labour, owing to recruiting and munitions work.

National Service.

Of course, electricity is totally incapable of entering into competition with gas in the metal industries for many operations to which the latter is now applied, and for three reasons: Because electricity is in comparison not in the same street for thermal value; because it cannot vie with gas in economy; and because the properties of gas render it of exceptional value for the processes of annealing, hardening, &c. We might add a fourth reason—that electricity, through the lack of substantial storage, could not possibly meet, without considerable cost in stand-by plant and increased daily outgoings, the heavy fluctuations in demand from hour to hour, and from day to day, that have to be encountered by the gas industry. We have seen what an immense average increase Birmingham has had to meet in the last six months; and it is stated that, for heating and power, the Sheffield Gas Company are sending out about ten times more than they were doing for these purposes before the war. The figures are averages, and do not indicate what considerable peaks and valleys there are, in many cases, in the output curve from hour to hour and from day to day. A few days ago, we heard of one gas concern in an industrial area, the output of which since the war began has shown a good average percentage increase; but the manager never knows in the morning what the day is going to bring forth. He has had days with 12 to 16 per cent. increase upon the day before, or upon the corresponding days of the previous year; and he has had days showing actual declines in output in comparison with the preceding day or the corresponding days of last year. This is due to the fluctuations in the character of the work proceeding in the factories in the supply area. Such variations would not, to put it mildly, be convenient nor a matter of comfort to the central station engineer.

Fluctuating Industrial Demand.

Of course, this enormous pressure in gas demand for industrial purposes is not general in the gas industry; but it may be said that national service in the provision of the essentials for high explosive purposes is practically universal. The country cannot afford that this should not be so. But all the conditions, it is plain, are against maintaining the standard of efficiency in trading competition at the highest level attained before the advent of these abnormal times. Of course, the men of the electrical industry will say that in some industrial areas they, too, are feeling the pressure of demand for power purposes, and that their competitive strength is seriously crippled (this applies equally to those gas undertakings without a good balance of cash in hand) by reason of the withholding of sanction to further spending powers, unless the expenditure is required in connection with munitions output. They, too, are short of men for dealing with expansions of business. Under the circumstances, the one industry cannot take much advantage of the other in unduly pressing competition. In fact, we should look upon it as a not very patriotic thing when one concern is working at high pressure to meet the country's needs for the competing concern, less pushed, to use the opportunity to enhance its own advantage. It would be tantamount to one man striking another who has his hands tied behind him.

Competition under the Circumstances.

The Newcastle-on-Tyne Electric Supply Company and the associated concerns appear to us to be trying to evade the stipulation as to preference being shown to any consumer or class of consumers. According to one of our electrical contemporaries, they have introduced a new charge, to be known as the "domestic." Under this, the consumer pays a settled charge on the lighting installation on the basis of 6s. per lampholder per annum. The charge, however, is made on only 75 per cent. of the total lampholders fitted; but "the tariff is conditional upon the consumer installing electricity for lighting purposes throughout." The fixed charge is payable in full for the first year, and in subsequent years at the rate of one-third for each winter quarter, and one-sixth for each summer quarter. The charge per unit above this is ¾d., without meter-rent. As to the tariff being "conditional upon the consumer installing electricity for lighting purposes throughout," in the South London case the Company made the same stipulation. At the instance of the South Metropolitan Gas Company, they had to withdraw it. In the Long Eaton case, consideration was shown to power consumers on condition that they used electricity only for lighting purposes. The local authority had to withdraw the stipulation.

A Newcastle Condition.

Petty comment is made by "Electrical Industries" upon our recent editorial article regarding the position of the gas industry in relation to lighting competition; but throughout the comment, there is not a single piece of evidence offered to destroy the accuracy of our contentions. Take this as an example: "It is sheer nonsense to suggest that gas has anything comparable with the convenience and excellence of indirect and semi-indirect illumination by electricity." Why it is "sheer nonsense" our contemporary is careful not to explain. Of course, samples of indirect and semi-indirect lighting using incandescent gas-burners did not happen, at the National Gas Exhibition and at the Ideal Home Exhibitions, to meet the eyes of the writer of "Gossip" in "Electrical Industries." He has never seen any illustrations in our columns, and in the illuminating engineering papers, showing the application of these systems to gas lighting. He never knew that Mr. William Sugg adopted the semi-indirect system for gas lighting for its decorative and diffusive effects before the electricity industry was compelled to utilize it for protecting people's eyes from its malignant glare. Take another statement: "Gas is *alleged* to have the advantage of lower intrinsic brilliancy, better composition [of light], and diffusive power." "Alleged!" That is the most, simply insinuating the contrary, that our contemporary has to say. Our electrical readers—and they are not few—will look upon their champion's comments as very weak. Now we invite him to show us positively where our statements in these respects erred, by giving us authoritative data supporting his contentions. Then we promise to discuss the matter very seriously with him.

A Confession of Ignorance.

The same "gossiper"—gossip is generally flimsy and unreliable—not very generously agrees that "gas-fittings have been brought to a high pitch of perfection," but he spoils the admission by adding "in imitation of electrical fittings." As a matter of fact, electrical fittings have been developed by the experience gained by the manufacturers of gas-fittings; and the manufacturers of gas-fittings—particularly in the Birmingham district—are the same people who largely supply the wholesale houses dealing in electrical fittings. There has been no imitation. To a very large extent the same fittings, in the main parts of the designs, are as suitable for gas as for electricity—in the one case gas is conducted through their tubular organism, in the other case electric wires. In the gas industry, we have nothing so ugly and so dangerous as a lamp being suspended at the end of a piece of flexible wire. As to the costs of similar fittings for gas and for electrical use, the latter puts the former into the shade. If the user of electricity desires something of an exquisite order, he has to pay very dearly for the gratification. The "Electrical Times" also complains of a piece of deception practised by the purveyors of electrical fittings through their catalogues. Illustrations are given showing fittings complete with shades, holders, wiring, lamps, glasses, and presumably with lead shot in the counterweight for rise-and-fall pendants; but the price quoted merely covers the body of the fitting itself. Example is given from the catalogue of the Ediswan Company, where a complete fitting is illustrated, and is priced at £4 11s. But a prospective purchaser of the fitting finds that the £4 11s. has to be supplemented by £2 4s. for the shade, by (say) 5s. for the wiring, by 16s. for half-a-dozen lamps, by 11s. 3d. for three glasses for the upper lights, by 2s. 6d. for the lead shot, by 4s. 6d. for the six holders, and by 1s. for the ceiling block. Thus the essential accessories run the consumer into a further outlay of £4 4s. 3d.; making the cost of the fitting complete £8 15s. 3d. We should want for the price something extraordinarily gorgeous in the way of a gas-pendant, with all fittings. Gas-fitting catalogues also illustrate pendants complete; but they invariably show what the shade and burners (of the size illustrated) cost in addition.

Fittings and Deceptive Prices.

Losses at Dundalk.

There is often a considerable difference between the reports of interested people and actual facts. The Germans are past-masters at this sort of thing. According to their reports, they repulse attacks as frequently as they are made; and their arms meet with success everywhere. The accumulations of what they have done and are doing according to the reports issued from Berlin ought before this to have carried the German-Austrian armies over the face of the entire Continent. But on the Western and the Eastern fronts, they have stuck fast. The electricity concern at Dundalk, according to one of our electrical contemporaries recently, was showing excellent progress. But when this comes to be translated into figures, we fail to see that there is anything about which to boast. Mr. George Airth, the Engineer and Manager of the Dundalk Gas Company, has occasionally let a little light upon this question; and now Mr. J. A. Reddy, the District Auditor, has in his report been making two or three revelations that are not altogether to the taste of those responsible for the administration of the electricity concern. He states that, in the accounts of the Electricity Department, the figures shown in the abstracts under the head of repayment of loans do not include the full sum due for the entire period—the balance having been paid out of the general town fund. Further, from the commencement of the undertaking up to March 31, the total sum paid in support of the concern out of the general fund amounted to £2068. It is probable this amount will be largely increased under present circumstances. There is nothing to be proud about there. Mr. Reddy also says that he noticed one or two cases in which the charges were not in accordance with the printed tariff; but he understands the tariff is under revision. There is nothing to be proud about in secretly departing from the tariff. It would be interesting to know if these people were receiving preferential treatment in contravention of the law governing the matter of charges.

Importance of the Salesman.

There are salesmen and salesmen; there are salesmen who are good, and salesmen who are bad. We have met both types; and the only results of contact with the latter have been to be very sorry for the want of ability on the part of the company or firm in choosing such representatives, and an expression of fervid hope that we shall never meet those salesmen again in, at any rate, a business capacity. Some salesmen do to the business of the concerns to which they are attached more harm than good; and therefore the quicker they are cleared out, the better. There was recently an article in the "Electrical Review" on the subject of the importance and training of the salesman; but the article starts with this most unhappy passage: "The salesman may be considered the life-sap to any concern, as upon the results of his activities the success of all industries depend." There is a grammatical error there through the omission of an "s;" and it is going rather far in claim to say that on the results of the activities of a salesman for one concern the success of "all" industries depends. However, there it is; and it is the considered opinion of Mr. R. P. Bennett, the author of the article. Still the importance of the salesman in creating business is great, as upon the results of his work the general development of the whole undertaking depends—from productive plant outwards, no matter the nature of the commodity. The company or firm may produce their commodities efficiently, and prices may be very moderate. But given bad salesmen (and, in the gas and electricity industries, bad fitters), the interests of the company or firm are seriously imperilled. Mr. Bennett advocates the salesmen-training methods that are in operation in the United States. They are somewhat elaborate. Nevertheless, there is something in the idea that the salesman should have a technical knowledge root and branch of the business, so that there shall be no danger of him damaging the interests of his employers by inadequate knowledge. In the works or factory, he is made acquainted with the methods of production and distribution, and, in the case of goods, of handling, packing, and dispatch. The training proceeds for a definite time in each of the departments. Then a period is spent in the administrative offices. Succeeding, time is passed in a preparatory school, where the methods of approach, attack, and the display of samples are learned. Then there are rehearsals in which a director of the company or firm is a supposititious customer, with whom the salesman seeks an interview, expatiates upon the goods he has for sale, and tries to effect a transaction. This must be a critical time in the career of the salesmen. But, of course, a successful salesman is born, not made; and no two possible customers with whom he will have to deal are exactly alike. While a full range of knowledge is therefore correct, it would be worse than useless to have the salesman tied up with formulæ, or to be incapable of action save in a mechanical sort of way. Though a salesman is born, and not made, his abilities want to be cultivated and specialized; but in the gas industry, we have seen all too little of the effects of such work—to the detriment of the industry. It is by some salesmen thought sufficient if they can talk of consumptions and capacities; beyond these particulars they get out of their depth, which should not be in an industry with technical foundation, and the progress of which is opposed by the sternest rivalry.

Mr. Thomas Bower, M.Inst.C.E., late of West Hartlepool, by will just proved, left estate of the gross value of £33,935.

THE COKING OF COAL AT LOW TEMPERATURES.

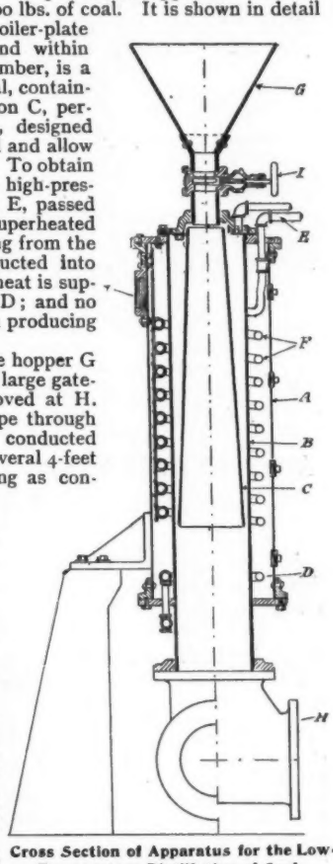
By S. W. Parr and H. L. Olin.

A "Bulletin" issued by the University of Illinois, just received, bears the title given above, and is a continuation of a former one [see "Journal," Vol. CXXII., pp. 533, 595]. The present experiments cover a series of studies made during 1911-13, on the coking properties of Illinois coal.

Previous experiments have shown that the formation of coke depends upon the presence of certain constituents having a melting point which is lower than the temperature at which decomposition or carbonization takes place. These products are, however, readily and easily oxidized, and the greatest coking effect is obtained where the opportunity for the minimum amount of oxidation has occurred.

Coals containing an excessive quantity of the coking substance produce a light, porous coke; the texture being modified by pressure and close packing of the charge. By the use of temperatures between 400° and 500° C. (752° to 932° Fahr.) the resulting products are of a type distinctly different from those obtained by the usual high-temperature procedure.

In the present research, the experimental apparatus was designed to carbonize about 100 lbs. of coal. It is shown in detail in the diagram, where A is a boiler-plate shell lined with asbestos, and within this, forming the coking chamber, is a shell B, of the same material, containing a cone of light sheet iron C, perforated with $\frac{3}{16}$-inch holes, designed to confine the charge of coal and allow free circulation of the gases. To obtain a non-oxidizing atmosphere high-pressure steam was admitted at E, passed through F, where it was superheated by the hot currents ascending from the gas-burner, and then conducted into the coking chamber. The heat is supplied by a blast ring-burner D; and no difficulty was experienced in producing the desired temperatures.



Cross Section of Apparatus for the Low-Temperature Distillation of Coal.

The crushed coal from the hopper G enters the retort through a large gate-valve; the coke being removed at H. The combustion gases escape through J; the distillates being conducted through an outlet pipe to several 4-feet lengths of 1-inch pipe, acting as condensers. The tars pass through a water-sealed exit at the bottom; while the gases, fairly clean, are collected in a holder.

As the heating progressed during the installation, a black pitchy substance dropped from the joints of the containing ovens; but it hardened immediately upon cooling, forming a brittle mass much resembling asphalt. This is undoubtedly the cementing principle which is instrumental in forming coke. In the decomposition of the resinic bodies, and in the deposition of cementing carbon, there occurs at the same time an evolution of large quantities of gases, which inflate the pasty mass and make the resulting coke more or less light and spongy—so much so, that certain coals, after being heated under conditions which allow free expansion, present the appearance of hardened froth, because of the excessive development of cell structure in the coke. This effect can be largely reduced by the application of pressure during the carbonization of the charge of coal or by the addition of inert coke dust to the coal before charging.

A sample of such a coke-breeze had the following composition:

Moisture . . .	1·85	Sulphur . . .	2·62
Ash	11·90	Fixed carbon . .	66·40
Volatile matter .	19·85	B.Th.U. . . .	11,243

With one particular coal it was possible to add 100 per cent. of this material and still produce hard, firm coke. Not only is the texture made firmer by this treatment, but the density is greatly increased.

Early in the course of the work, the study of the products resulting from the distillation of bituminous coals at low temperatures suggested the possibility of using them as fuel for gas-producers. Previous experiments showed that the moderate temperature of the preliminary heating period was sufficient to expel the major part of the tar-producing substances, and that the residue yielded gases that were remarkably free from heavy condensation products.

The producer used was a No. 3 Otto, designed to operate on

anthracite pea coal. The fuel used was the semi-coke obtained at 400° to 550° C. It was light and porous, and varied in size from ¾ inch to 2 inches diameter. Its composition was approximately that given above. No trouble was experienced in working other than that due to the lightness of the material, which necessitated the fuel being poked about once in an hour, to cause it to feed as rapidly as it was burnt. The producer gas contained:

	Per Cent.		Per Cent.
Carbon dioxide	4·15	Hydrogen (estimated)	11·80
Carbon monoxide	21·10	Marsh gas	1·50
Oxygen	0·30	Nitrogen	61·00

The efficiency of the producer worked out at:

	Per Cent.
Grate efficiency	98·2
Hot gas efficiency based on high heating value	74·4
Cold ,, ,, ,, low ,, ,,	64·9

A test of some of the original low-temperature coke in an ordinary house open fire grate showed that the coke ignites readily, it retains its shape through the process of combustion, a glowing bed quickly results, and no smoke is produced. An analysis of the tar produced at the low-temperature distillation of coal showed:

Below 210° C.	17·2 per cent.
210° to 325° C.	52·7 ,,
Above 325° C.	30·1 ,,

Further fractionation of the light oil fraction (up to 210° C.) yielded the following:

Specific gravity, ·966.

	Percentage on Basis of Crude Tar.		Percentage on Basis of Light Oil Fraction.
Light oil fraction	17·20	..	100·0
Phenols (and other acid substances)	5·70	..	33·0
Amines (and other bases)	0·90	..	5·3
Paraffins	3·12	..	18·1

A further refractionation after acids and bases had been removed gave:

Between 20° to 75° C.	0·25	..	5·26
75° to 95° C. (crude 90 per cent. benzol)	0·38	..	2·10
95° to 125° C. (crude toluol)	1·33	..	7·36
125° ,, 170° C. (crude solvent naphtha)	4·77	..	26·30
170° ,, 200° C. ,, heavy ,,	2·67	..	14·73
200° ,, 210° C. ,, ,, ,,	1·32	..	7·30

Naphthalene is absent; and the free carbon in the crude tar is less than 2 per cent.

A CHEMICAL INTELLIGENCE DEPARTMENT OF THE BOARD OF TRADE.

A long discussion took place at the meeting of the London Section of the Society of Chemical Industry yesterday (Monday) week with regard to a scheme by Dr. M. O. Forster for the establishment of a Chemical Intelligence Department as a branch of the Board of Trade. Dr. H. E. Armstrong was in the chair.

Dr. Forster, who put the proposal forward originally at the annual meeting of the Society in Manchester a short time ago, explained it a little more in detail. He complained of the neglect of chemistry in this country both by the general public and the Government, the result of which had been to put us, on the outbreak of war, at a serious disadvantage compared with Germany. Unless definite steps were taken to establish chemistry upon such a footing that it could assume its proper place in the national economy, the restoration of European peace would be the signal for the restoration of British chemistry to its former ignominy. Those who had striven in the past to improve the status of the industry had failed through circumstances being too strong for them. The moment, however, was opportune for a scheme of the nature he had in mind, because the Government was now taking the advice of chemists to an extent hitherto unknown. Briefly, the scheme is to institute a branch of the Board of Trade as a Chemical Intelligence Department, the work of which might be subdivided as follows:

A.—Technical.

1.—Classification of chemical discoveries at home and abroad as evidenced by (*a*) patent specifications, (*b*) scientific memoirs.
2.—The distribution of chemical information to scientific inquirers and to manufacturers seeking new developments or desiring to improve existing processes.
3.—Collection of information regarding the most suitable materials for constructing chemical plant and apparatus on a manufacturing scale, and the most convenient sources for the supply of such plant and apparatus.
4.—Tabulation of the bye-products arising in various chemical industries, and consideration of the most profitable ways of utilizing them.
5.—Presentation of problems arising out of (3) and (4) to the numerous research chemists throughout the country, such problems to be offered under proper discretionary safeguards and appropriate remuneration.

B.—Techno-Commercial (By Co-operation with the Board of Trade).

1.—Classification of various chemical products in respect of their distribution throughout the world, with ruling prices, tariffs, cost of transport, and, where possible, cost of production.
2.—Classification of resources of the Empire and friendly nations of raw materials for the purpose of finding novel applications of them.

C.—Techno-Educational (By Co-operation with the Board of Education).

1.—Classification of data regarding opportunities for chemical instruction and research in various parts of the Empire, and comparison of these with those offered in foreign countries.
2.—Consideration and possible improvements and extensions in existing Imperial methods suggested by the information thus gained.
3.—Consideration and, where possible, application of methods by which wage earners of good conduct and adaptability might be trained as technical foremen.

The cost of working such a department the speaker put at, roughly, £5000 per annum; the staff consisting of a controlling chemist, four or five assistant chemists, a librarian, and a clerical staff of six or eight.

Mr. Walter Reid, Dr. Alexander Scott, and Mr. Gordon Salamon supported the scheme in general. The first-named, however, hoped everything would be done to prevent any interference with the work of consulting chemists. Mr. Salamon pointed out that, unless care was taken in working out the details of the scheme, there was a danger of it being known as one for the synthetic production of red tape. It would be better for such a department to work in co-operation with all the Societies in the industry, who should appoint a Joint Committee to supervise the work.

Professor Donnan agreed with this view.

Mr. J. L. Baker said there was at present a Committee representing all the chemical societies; and if this were to do its work properly, it should be able to carry out a lot of the pioneer work, and devise a definite scheme by the time the war was over.

Mr. E. J. Boake, Dr. F. M. Perkin, and one or two other speakers emphasized the point that any such department as that proposed should be paid for by British capital, and the information made available only to British chemists. They also supported the suggestion that an Advisory Committeee appointed by the various Chemical Societies of the country should control the new department; the members of such Advisory Committee being varied from time to time in the same way as the members of the Advisory Board of the National Physical Laboratory.

Dr. Travers doubted whether such a department could be run for £5000 a year. In his opinion, the controlling chemist should be paid £1000, and his assistants £500 a year. At the same time he failed to see how the information which might be obtained by the Department would benefit manufacturers, seeing that it must come from the manufacturers in the first place. He thought that there was a great need for the chemical industry to organize itself.

Mr. C. S. Garland expressed similar views, and advocated a combination of all the Chemical Societies into one, the work of which should be subdivided in such a way that chemists could subscribe to the section which dealt with their particular interests. In this way he anticipated good results.

Mr. W. J. A. Butterfield foresaw that the proposed department would be made use of by two classes—namely, prosperous manufacturers who might be of a mean turn of mind and hoped to get useful information without paying for it, and, secondly, the impecunious inventor or manufacturer, who looked to the State to help him with advice so that he might become prosperous. He failed to see how the department, if it were to be of any use, could work without the advice of consultants and technical men; and surely these should be paid professional terms. No account of this had been taken in the estimated expenditure.

Dr. D. A. Sutherland and Dr. Miall also held the view that the chemical industry needs organization within itself before approaching the Government with any scheme.

Representatives were present from the Board of Trade and the Board of Education; their function being to report to their representative Presidents their views of what took place.

The Chairman, in winding-up the discussion, said that the very fact that two representatives of Government Departments were present and maintained the old-fashioned aloofness, was an indication of the necessity for change of some sort in the relations between the Government and industry. Evidently this matter must be taken up by the Society of Chemical Industry and the other Societies in the industry, and a scheme formulated so that the Government should not be merely asked, but should be required to take steps. In supporting the suggestion that an Advisory Committee should be formed to control the Department, he said chemists could not be spared to be appointed as permanent officials. They were badly wanted in the factory, and, moreover, men put to ornamental work of this kind could not keep in touch with the industry.

Dr. Forster briefly replied; and the matter will now be dealt with by the Council of the Society.

SOCIETY OF BRITISH GAS INDUSTRIES.

The Autumn General Meeting was held on Thursday last, at the Trocadero Restaurant, Piccadilly Circus, W. Alderman F. Templer Depree, J.P., the Chairman of the Council, presided over a good attendance of members. Upon this the Chairman, in opening the proceedings, expressed congratulations, in view of the fact that so many of the firms are working hard for the Government on munitions.

Apologies.

The Chairman remarked that he had to explain that the Vice-Chairman (Mr. H. M. Thornton) had been suddenly called away, and regretted very much that this prevented his appearance at the meeting. They had also a letter, written on behalf of the President (Sir Alfred Keogh, K.C.B., LL.D.), explaining the cause of his absence.

The Secretary (Mr. Arthur L. Griffith) read the letter, which stated that Sir Alfred had asked the writer to express his regret that he could not take the chair at the meeting, as he would have liked to do. His work at the War Office quite precluded his acceptance of any other engagement, which, as might be imagined, was very heavy as well as onerous.

Report on the Work during the Past Six Months.

The Chairman then read the following statement:

In presenting this brief report of the transactions of our Society during the past six months, it is not my intention to detain you at any length, because I consider that, at a meeting of this kind, more good can be obtained by free discussion among the members themselves, with possibly some hints for future working and development, than by listening to a cut-and-dried statement of what has already taken place.

The one formal announcement of importance I was desirous to make was with reference to our new President for the coming year; and this I am not at present in a position to do. We are all fully aware of the reasons that have, unfortunately, deprived us of the presence and assistance of our esteemed President, Sir Alfred Keogh, and can but regret that the condition of the war necessitates his still devoting his full time, and all his energies, to carrying out the important duties he has been called upon to render to the War Office and to His Majesty's Army. The matter of the nomination of a successor to the presidency has been left in the hands of Mr. Yates and myself.

During the past few months most of our members have been very busy on munition work for the Government. A Sub-Committee was appointed by the Council in July last to see in what way the members could help each other in this matter. Meetings were held and a letter sent to all firms in the Society, and a summary of the replies received was tabulated, by which it was found that most of the firms were either fully or partly engaged on war munitions. It was thought desirable to bring firms who can undertake more work into touch with one another; and lists setting out those in the various districts were sent to all firms from whom replies had been received. The Council hope should any firms get inquiries, either direct from the War Office, Admiralty, or their local Munitions Committee, and find that any contract obtained is greater than they can undertake, or there are parts they require and do not themselves manufacture, they will get into touch with any of the firms set out in the list. I am pleased to report that, from a number of letters received, our members expressed their appreciation of the action taken by the Council. The Secretary of the Society is at all times willing to place his services at the disposal of any members for this purpose.

Your Council have invested the sum of £100 of the Society's funds in the new 4½ per cent. War Loan.

The King paid a visit to Leeds at the end of September and spent several hours visiting munition factories. He also visited the Leeds University, and—under the guidance of Professor Arthur Smithells, one of our Vice-Presidents—was taken through the various departments. In the Chemical Lecture Theatre there was a demonstration of the use of poison gas in warfare. In the Department of Coal Gas and Fuel Industries His Majesty noted the important work which is being carried on in regard to the supply of explosives.

In connection with the work at Leeds University on ventilation research, it is interesting to note that the Gas-Stove Section of our Society has been making experiments on the subject for many months past, and the following remarks in Professor Cobb's annual report are of great interest at the present time:

> Most immediately applicable to practice is probably the demonstration that even the most modern types of gas-fires differ so much among themselves in the degree to which they effect the ventilation of a room when burning under the same conditions. The usefulness of the work of this course will not, I think, be questioned.

It is very pleasing to note that, at the invitation of the Institution of Gas Engineers, Professor Cobb has joined the Committee on Refractory Materials, in which question our Society has taken so deep an interest.

The Joint Committee of members of the Institution of Gas Engineers and our Society who are holding an inquiry on the life of gas-meters have reported that progress has been made with the preliminary work of the investigation; and we hope that satisfactory results will follow on their deliberations. We regret to have to record the death of Mr. Edward Allen, one of the members of the Institution on the Committee, and also of Mr. Joseph Hepworth, one of the members representing the Society—both of whom took a great interest in the matter. The Institution have suggested that the two vacancies on the Committee should not be filled up; and this has been approved by our Council and the members of the Meter Section. Reference must also be made here to the loss that we have all sustained by the death of Professor Vivian B. Lewes. Many of us who have had the opportunity of meeting him, more particularly in the demonstrations that have from time to time taken place in the gas industry, knew him as a clever and genial lecturer. As such, there was no one who could approach him in the gas trade or any other trade. I feel that his loss is a very personal one, and that all those who had the pleasure of knowing him well, as I did, sincerely mourn his loss.

The British Commercial Gas Association is continuing its good work; and its advertising propaganda is being pushed forward in spite of these troublous times. We hope all the members of our Society will show appreciation of their action by giving it their best support, as the work that is being done must be for the benefit of every firm connected with the industry.

The Society's prizes to students in connection with the City and Guilds of London Institute examinations in Gas Engineering and Gas Supply have been awarded as follows:

Gas Engineering—Honours Grade.

1st Prize, £3 3s. .	Leonard Howard Thomas, Draughtsman in the Nechells works of the City of Birmingham Gas Department.
2nd Prize, £2 2s. .	Wilfred Baker Claridge, Assistant at the Gas-Works, Harpenden, Herts.

Gas Supply—Honours Grade.

1st Prize, £3 3s. .	John Tattersall Haynes, on the Engineer's Staff of the Liverpool Gas Company.
2nd Prize, equal, £1 1s. each	Albert Harry Manning, Chemist and Draughtsman to the Rotherham Corporation Gas Department. Leonard Howard Thomas.

From acknowledgments received, these prizes were much appreciated. We are pleased to congratulate Mr. Thomas on his dual success.

To encourage students in gas-fitting, the Council have decided to offer the following yearly prizes in the examinations:—

First prize, Honours Grade	Three guineas
Second prize, do.	Two guineas

As, however, the examination this year (being the first one) was of an experimental character, it has been decided, on the advice of the Secretary of the Examinations Board, not to award these prizes until next year.

The Institute of Industry and Science having asked the Society to furnish replies to certain questions in reference to credit facilities given by British banks, as the London bankers were going to consider the whole question, a letter was sent out to all our members; and as a result a considerable amount of valuable information was obtained which was summarized and sent to the Institute, from the Chairman of which we received a letter of thanks, stating that the summary was a most interesting document and would be of great assistance in developing the question at issue. We trust good may result from the bankers' deliberations.

With regard to the shortage of railway waggons which was referred to by the late Chairman, Mr. Broadhead, at the annual meeting in March last, we are pleased to report that the proposal for the pooling of railway trucks has not been lost sight of—representations having been made to the Government and the Railway Clearing House, as at a recent meeting of the Coal-Mining Organization Committee at the Home Office the views of supporters of the scheme which suggested that not only would its adoption save labour but that goods transport would be facilitated and cost of carriage be proportionately reduced, strongly appealed to the Committee, who adjourned the meeting so that an opportunity might be afforded of meeting the Railway Managers and placing the scheme before them. We feel sure that the scheme, if carried through, will be of great benefit to our members in all parts of the country, and to traders generally, and hope it will be decided upon by the Government. I am sorry Mr. Broadhead has not heard anything further about this matter.

I shall now be pleased to hear any remarks upon the report.

DISCUSSION.

Mr. J. W. Broadhead thought the members would all agree with him that the Chairman was to be complimented on his report. It showed that the Society had been doing a large amount of work during the past half year; and it was, in fact, even more than was reflected by the report. However, it indicated that the Society was continuing its good work, and was deserving of the full confidence and support of the members. With reference to the visit of His Majesty the King to the Leeds University, he (Mr. Broadhead) had the pleasure, as the Society's representative on the Livesey Memorial Committee, to be present on the occasion. The other side of the gas industry was represented by Mr. John Bond, of Southport, who went at great inconvenience, owing to the short notice he received. However, the King's reception was quite an informal one. Regarding the question of railway

waggons, he was sorry to say that the efforts that had been made to secure improvement had not yet borne fruit; and he was afraid that it came to this, that, if anything was going to be done, it would have been accomplished before this. Business had undoubtedly been very much hampered, not only through shortage of trucks, but owing to the railway lines having been periodically closed for military purposes, which could not of course be avoided. The pooling of the different railway companies' waggons would, there was no doubt, have very greatly improved matters. The Chairman had made a few remarks regarding the British Commercial Gas Association, and had spoken about the support that the Association deserved from the members of the Society. He (Mr. Broadhead) thought the members would agree with him, that the Association was doing an immense amount of good, and that every penny that was subscribed was expended in a useful way. Some members of the gas-supply industry, however, thought that the members of the Society were not doing so much as they ought to do. But he considered that £2000 odd out of a total of £15,000 was perhaps not really an amount of which to be ashamed, and particularly when they took into account the vastly larger capital that was employed in the manufacture of gas, as compared with that employed in the manufacture of apparatus. The gas profession were justly proud of being able to say that 80 per cent. of the quantity of gas output was represented in their subscriptions. This looked very handsome; but when they were told that out of the total number of gas undertakings, only about 500 subscribed, and not all of these on the full basis, it meant that only about 33 per cent. were subscribing. Surely, therefore, the members of the Society might say that the gas undertakings ought to do somewhat better than that. He understood from the Secretary that something like 60 per cent. of their members subscribed. However, the Association were doing their best to get all the gas undertakings to fall into line on the full basis. This being so, the Society must try to get every one of their members to subscribe on a liberal scale to the good work that the Association were doing. He thought the Chairman had every reason to be pleased with the proceedings of the Society over which he had presided so well during the last six months.

Mr. G. H. Pearson Perry observed, with reference to the subject of railway waggons, that there had been a great shortage; and the situation had not been much improved.

After a little more discussion, the report was unanimously adopted.

The Gas Industry and the Government.

The Chairman said there was one topic upon which he did not touch in his report, and that was as to the result of the deputation the previous week to the Explosives Department of the Ministry of Munitions, in connection with various matters that have been brought before the British Commercial Gas Association and their own Society. The Government (through the Treasury and the Local Government Board) were withholding sanction to the raising of capital by gas companies and to loans to gas undertakings owned by local authorities for the erection of gas plant and the purchase of necessary gas appliances. Yet the Munitions Department had been issuing circulars lately pressing the gas industry to supply as great a quantity of toluol as possible for the manufacture of high explosives. The Parliamentary War Savings Committee had been urging the public to use gas and gas coke instead of coal, so as to ensure economy for themselves and toluol for the Government. The War Office and Admiralty were also calling for more men; for the employment of women in factories, on farms, and upon all classes of industrial, instead of domestic, work; and for the increased output of munitions. To reduce industrial labour, manufacturers were putting down gas-furnaces and other apparatus in lieu of coal-fired plant, as the former required far less labour to operate than the latter. To reduce domestic labour, householders were ordering gas cooking and heating stoves and gas-heated hot-water circulators by tens of thousands. For the purchase of these, either capital was required by the gas undertakings if they were lent or hired by them to the public, or the money must come out of the purse of the public if the stoves were bought by them outright. The financial effect was the same. For the production of munitions with the utmost speed and a minimum of labour, manufacturers were installing gas-engines, furnaces, and other gas-heated apparatus in large numbers. This was one side of the picture. On the other side, the War Office were not using gas as fully as they might, either in buildings taken over temporarily for Army Pay Corps and other purposes or in new premises for which a supply was available; and the Treasury and Local Government Board were refusing financial facilities to gas undertakings for the purchase and supply of gas cooking, heating, and hot-water appliances, or for the carrying out of extensions of manufacturing plant required to supply larger quantities of gas. It was urged by the deputation that the various Government Departments having control of buildings (the War Office, Admiralty, Office of Works) should be instructed to use gas wherever possible both for light and as a fuel; and that the financial restrictions imposed upon gas undertakings at present should be promptly relaxed. The deputation consisted of the President of the Institution of Gas Engineers (Mr. John Young), the Hon. Secretary (Mr. W. E. Price), the Chairman of the Executive of the British Commercial Gas Association (Mr. F. W. Goodenough), and he (Alderman Depree) as Chairman of the Council of their own Society. They had a very interesting reception from Sir Sothern Holland on behalf of Lord Moulton. The first suggestion he made was that they were applying to the wrong department. This, of course, was what was invariably done. A deputation was no sooner arranged, and somebody seen, than they were told that it was not the business of that department, but of another. Although they were talking about munitions, they were informed that it was the Board of Trade they ought to have seen. However, they impressed upon Sir Sothern the desirability of the matter being accorded some consideration; and he expressed himself as being sympathetic, and said the matter should have attention, They all knew what that meant. Whether they would be prepared to let the matter rest there he did not know. Personally, he should like to see it carried a bit farther. Mr. Mason, who was present as Secretary of the British Commercial Gas Association, was not likely to let the matter die out without some further effort. He (the Chairman) thought the members would like to know that a careful eye was being kept on the matter.

Firms with German and Austrian Connections.

The Chairman said there was just one other question that he wanted to mention. At the last meeting, a proposition was put forward by Mr. Glover, and seconded by Mr. Milbourne, that the Chairman and Vice-Chairman should be requested to draw up a rule to be submitted at the annual meeting in 1916, with the view of excluding firms from membership who were not acceptable to the Society. The rule had not yet been drawn up; but it did not require so long a period as from now to March next in which to do it. However, he thought that at this meeting, he would take the opportunity of drawing attention to the proposed rule. There were some firms who were subscribers to the Society who had to a certain extent a foreign connection; and it was considered that these firms, before any special rule was adopted, would perhaps like to know what was the feeling of the members, and so give them an opportunity of gracefully withdrawing. He did not think he need labour the point. Looking through the list of members, it would be seen that there were firms who, if they had not at the present time very considerable trading with German and Austrian firms, or were worked with German and Austrian money, were associated more or less with foreign trade. Under the circumstances, as this was the Society of "British" Gas Industries, it would be better for those firms to retire from membership.

THE WAR ON BRITISH TRADE.

Mr. R. J. Milbourne, Assoc.M.Inst.C.E., F.C.S., read the following paper on the above subject:

I should like to draw the attention of members of the Society of British Gas Industries to the articles now appearing in the "Engineer," commencing with the publication of Oct. 15. No doubt many members have had their attention already called to these articles by the well-known firm of Colonial Agents, Messrs. W. Coward and Co., of Bishopsgate, London, who are taking a very keen interest in the matter.

In these articles we are very plainly told that the Germans are already taking vigorous steps to retain, as far as now lies in their power to do so, their own foreign trade and trade connections even during the war, and to baulk and jeopardize ours and that of our Allies. It is forecasted that we are to meet competition much more severe than ever we have felt it before in the commercial war that is prophesied. We are informed in these articles that so serious a view do Russia, France, and Italy, and even stricken Belgium, take of this matter that they have Committees already at work. If Great Britain is not already engaged in marshalling her commercial forces to deal with the matter effectively with a well-thought-out policy, she may find herself as ill-prepared in regard to this matter as she was in the matter of defence at the beginning of the war.

The commercial aspect is not the only one. There is technical research, and the encouragement of invention that must not be overlooked. Mr. J. Ferguson Bell, who is well known to all of us, gave some excellent advice in an address he delivered before the Derby Society of Engineers last month. He said it has been reported through Reuter's Agency that an enormous stock of commodities of all descriptions has been prepared by German manufacturers, which it is their great endeavour to turn into cash at the earliest possible moment by any means that they can discover; and the Germans are showing no scruples in the pursuit of their end. One of the practices employed is to counterfeit all sorts of trade marks, especially of commodities manufactured by firms of high repute in neutral or allied countries; and by this means they have already obtained opportunities of sending their goods in considerable quantities throughout the world. Switzerland and other neutral countries are naturally open doors to the whole world. It would seem to be the duty of the Allies to prevent Germany realizing its assets in this fraudulent manner. The irony is that neutrals not only sell to other neutrals and our Colonies, but send over German goods which are being sold in this country disguised under counterfeit trade marks. It is evident a commercial and industrial war will be waged by our enemies with the same ruthlessness and neglect of all scruples as we know from bitter experience characterize their military operations, which are a disgrace to civilization.

Dr. J. A. Fleming, in a recent lecture at University College, London, on "Science in the War, and after the War," points out that we must say "Good-bye" now and for ever to those easy-going British methods which have held us in the past. What we

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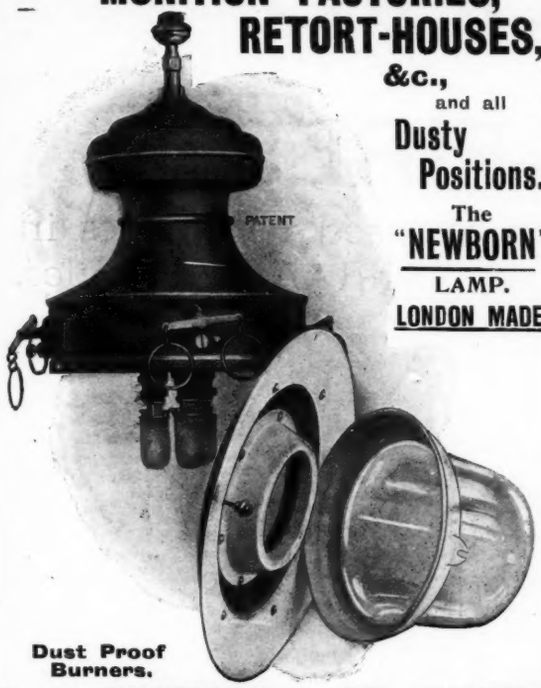

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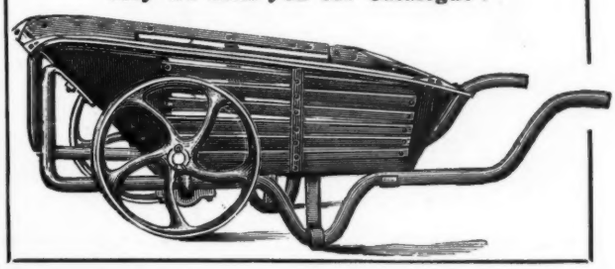

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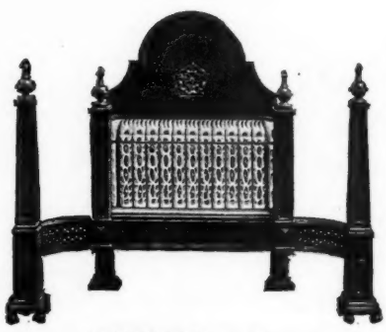

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require is to obtain a higher degree of efficiency in all our operations. For years we have been buying dyes, drugs, chemicals, glass, optical instruments, machinery, and hundreds of other manufactured articles from Germany and Austria. We have no need to buy, but simply because we shirked the effort and new methods necesary to make them as cheaply and as well at home. In many instances, we actually exported the necessary crude products for their manufacture, and re-purchased finished goods.

It seems to me that the Society of British Gas Industries might assist materially in these matters that concern the many manufacturers it represents, and perhaps take some definite action.

DISCUSSION.

Mr. H. James Yates proposed a vote of thanks to Mr. Milbourne for his paper. The warning as to the matter that he had introduced came none too soon. The Britisher was now waking-up to the fact of what Germany was doing by most unscrupulous methods, and proposed to do after the war was over.

Mr. F. G. Cockey seconded the motion with much pleasure.

The Chairman said he was certain that the more the members thought over this matter, the more importance they would attach to it. They knew that at the present time there were goods used in connection with the gas industry which were being imported into England in very large quantities, and which were German or Austrian make. The matter had been under discussion by the Council for a long time; and they were not going to let it rest where it was. They knew that hundreds of thousands of mantles were brought into England, marked "Made in Holland," or "British Made." Under the British mark on some goods, one often found in small letters "Made in Germany" or "Made in Austria." This was so with a large quantity of glassware that was coming over here. These goods were not all being put on the market at the present time; and when the war was over, their enemies would be in the position to glut the market with them. A lot of goods were now being manufactured for the purpose of capturing British trade when the time came. The question was also an important one to British Colonies and neutral countries, especially foreign-made articles that bore the British trade mark. For instance, for years "Sheffield Made" had been put on large quantities of German-made razors that had been exported to foreign countries and the colonies. This, he believed, was still going on. This country did not take the measures that it ought to do to counteract this sort of thing. Mr. Yates reminded him that they had evidence before them of gas undertakings that were at the present time importing foreign glass, and using it because they said they could not procure it in this country.

The motion for the vote of thanks was heartily agreed to.

Mr. F. J. West thought that the subject brought forward by Mr. Milbourne was one deserving considerable attention from the Society. He was pleased to hear the Council had the matter under consideration. It was recently his privilege in the Manchester City Council to second a resolution to the effect that no contracts would be placed in future with German firms, and no contracts would be placed in this country where the proportion of German capital in the business was beyond a certain figure. This resolution was unanimously carried. In the discussion on that occasion, mention was made of the clever way in which the Germans introduced their specialities in this country under the guise of a British combine; while an examination of the shareholders' list generally revealed the fact that five-sixths of the capital came from Germany, and only probably one-sixth was British. It had been demonstrated time after time how dependent this country had become upon Germany for certain products, and what a long time it had taken for this country to recognize the fact, and to get into line, and put its house in order. He suggested that the Council should at the earliest opportunity approach the Institution of Gas Engineers, and ask them to revise the standard contract clauses, for the purpose of preventing German and Austrian goods being used in future. This matter was one that rested very much with the buyers; and unless British manufacturers had the sympathy of buyers in this matter, he was afraid that they would not get much further. In addition to revising the standard contract clauses, he thought it should be possible to draw up some heads of agreement with regard to dealing with concerns where German capital existed. Also some effort might be made to establish an investigation into these trade marks to prevent the market being flooded with German articles under the name of "British."

Mr. Thomas Glover (London) said if this matter was taken up in the way suggested by Mr. West, it occurred to him that it was not only a question of dealing with it under the standard clauses, but it was also one that could be judiciously mentioned to the British Commercial Gas Association, because it was common knowledge to everybody present that many of the most prominent members of the British Commercial Gas Association were exactly those who had been referred to as buying German lamps, mantles, and glass.

The Chairman remarked that the Secretary reminded him this matter was taken up some little time ago by the British Empire League; and a big meeting was held at the Queen's Hall, under the presidency of the late Duke of Argyll. The Secretary attended it. An Association was formed, called the British Empire Trade Mark Association; and they got very influential support. The idea was that all goods made in this country or in the colonies should bear the mark showing origin in the British Empire. The Board of Trade, however, refused to register the British Empire trade mark. So the matter fell through.

Mr. W. D. Helps said in regard to the remarks made by Mr. West as to some gas undertakings encouraging German and other foreign-made goods, in fairness it should be said that there were by no means unimportant gas undertakings that were shutting the door against foreign goods, and even goods that had doubtful origin. These gas undertakings were stronger in their resolve to-day than twelve months ago not to buy German or Austrian made goods. He had two or three especially in mind. He had twitted the managers on the subject, and had suggested that, within three months from the time the war was over, they would be again buyers of goods from abroad. But the managers said that they would not, and their directors were heartily supporting them in their resolve. They wanted more gas undertakings of this character, and doing the same thing.

Mr. Milbourne said he was extremely obliged to the members for the vote of thanks which had been so cordially passed for the paper. He was sure that most of the members thought it was quite impossible to take an optimistic view of the present position of affairs. They had got to look at the business side of the country after the war was over. The suggestion that Mr. West made was a good one; and he thought the matter might be commended to the Council of the Society. It must be remembered that France had already established a very powerful Committee; and they were laying the foundation-stone now for a definite policy in the great economic struggle which must take place at the conclusion of the war. They did, he believed, as business men recognize the fact that most of them were working now under different conditions from what they generally did. Most of the members of the heavy section were now engaged on munitions work; and as soon as the war ceased, all this would suddenly stop, and it would be very difficult to find the necessary trade to keep many of the large works going. They had to recognize, too, that as soon as peace was declared, they had to be prepared to resist the German commercial invasion which, he felt convinced, would take place, unless some action were started in the matter.

The Yates Golf Cup.

The Chairman then presented the Yates Golf Cup to the winner—Mr. Charles S. Bennett, of Gibbons Bros., Limited, and B. Gibbons, jun., Limited.

Vote of Thanks to the Chairman.

Moved by Mr. Broadhead, and seconded by Mr. Cyril G. Davis, a hearty vote of thanks was accorded to the Chairman for presiding and for his hospitality in inviting the members to take tea together.

The Chairman, in replying, observed that it was a great pleasure to him to be of service to the gas industry at any time.

The members were the Chairman's guests at tea, which was served in the adjoining room. This gave a little time for social intercourse before separating.

London and Southern District Junior Gas Association.—At a meeting of the Association on Friday evening next, Mr. H. Hartley, of the Richmond Gas Stove and Meter Company, Limited, will give a lecture, illustrated by lantern slides, entitled the "Development of Gas-Fires, 1913-15."

Institution of Water Engineers.—The twentieth annual winter meeting will be held at the Geological Society's apartments, Burlington House, W., on Friday, the 10th prox., commencing at 2.30 p.m. A discussion will be invited on "The Necessity for Defining the Term 'Domestic Purposes' in General and Private Water Acts." The election of the President and Council for the year 1916-17, also the election of the Auditors for the year 1916, will take place at this meeting.

Export Licence Application Forms.—The attention of exporters of coal and gas coke is, says the "Times," specially directed to the announcement issued by the War Trade Department on Oct. 14, in which it was intimated that, on and after Nov. 1, it would be necessary for a revised form of application for a licence to be used. As applications are still being made on the old form, it is advisable to warn exporters that applications cannot be considered by the Coal Exports Committee unless the new form (dark blue) containing a declaration that the proposed shipment is in pursuance of an existing contract or in execution of a definite order, is used. Any applications received on the old form must therefore be returned. The new forms are obtainable at the Custom House at coal ports.

Certification of Cement for Export.—The Imperial Institute notify that a laboratory for testing cement has now been added to the establishment of the Scientific and Technical Research Department of the Institute. In certain countries, such as Argentina, the national Government have adopted an official specification for cement to which all cement intended for use in the construction of public works must conform. The Argentine Government also require the certification of such cement by a laboratory recognized for the purpose by the Government of the exporting country. H.M. Government have now recognized for this purpose the cement-testing laboratory of the Imperial Institute, at which analyses and tests will in future be conducted for British-made cement for contractors, engineers, manufacturers, and others desiring to export cement to the Argentine and other countries where a Government certificate is required. Firms requiring such assistance should communicate with the Director of the Imperial Institute, South Kensington, S.W.

GAS AS A CASE-HARDENING AGENT.

By Alfred H. White and Homer T. Hood.

[A Paper submitted at the Twenty-fourth Annual Meeting of the Michigan Gas Association, Detroit, Sept. 24.]

Introduction.

It has been known for several centuries that it was possible to form a hard steel skin upon mild-steel articles by embedding them for a number of hours in charcoal maintained at a red heat. Within recent years scientific investigation has shown that it is not the solid carbon which exerts the most powerful carbonizing action, but that it is the gaseous carbon monoxide formed through the action of air enclosed in the spaces between the carbon grains or evolved from materials added, which effects the case-hardening. The most comprehensive studies have been made by Giolitti,* who has issued a book on the subject which has been recently translated into English. He strongly favours carbon monoxide as a carburizing agent, and states that hydrocarbons in high concentration are objectionable.

Illuminating gas has been used for some years commercially as a case-hardening agent in this country, with excellent results in the hands of some operators, and with perhaps indifferent success in the hands of others. The case-hardening of steel is an important industry, and is usually carried out in cities of sufficient size to have gas plants; so that the study of the advantages and limitations of illuminating gas as a case-hardening agent is of material importance to the gas and metallurgical industries.

The results of these tests show that it is possible to produce excellent results and almost any type of case-hardening with unenriched coal gas. There is no reason to doubt that any of the usual types of city gas will accomplish the same result, and that the method is capable of wide and advantageous commercial applications.

In the following argument there will be a brief review of the general processes of carburization, followed by a more specific discussion of the methods to be used in carburizing with gas.

General Processes of Case-Hardening.

The purpose of case-hardening is to manufacture steel objects with a hard, resistant surface over a soft, tough centre or core. The objects are first machined out of plain carbon or alloy steel, containing generally less than 0·25 per cent. of carbon, which is soft and tough and easily machined. The surface of the objects is then carburized—*i.e.*, the surface is changed from a low-carbon steel to high-carbon steel, which will harden on heat treatment and produce an object with a hard, wear-resisting surface and a tough, ductile core, so that the object can not be easily broken. The carburizing is accomplished by exposing the steel at a high temperature to the action of a carburizing agent. The carburizing agent which is the source of available carbon may be a solid such as charcoal, bone, or leather scrap, with mineral matter such as barium carbonate frequently added, a liquid such as molten cyanides, or gas such as illuminating gas, carbon monoxide, or oil gas. There are five factors governing the process of carburizing:

1. The composition of the steel.
2. The nature of the carburizing agent.
3. The temperature of carburizing.
4. The concentration of the carburizing agent and the intimacy of its contact with the steel.
5. The duration of carburizing.

The quality of the finished piece depends also on the nature of the subsequent treatment. In order to produce a hard surface, the pieces must be quenched from above their critical temperature; but if the steel is quenched directly from the carburizing heat it will be brittle, and the structure of case and core will be coarse and weak unless the temperature of carburizing has been kept very low, or unless the raw material contains one of the alloying elements which retard grain growth. If the carburized steel is allowed to cool, and is reheated to a temperature only high enough to refine the grain of the high carbon case, and is then quenched from this temperature, the grain of the carburized zone will be very fine, but that of the core will still remain as coarse as at the end of the carburizing operation. In this condition the line of demarcation between case and core is very sharp.

In order to get the toughest possible steel, the piece must be cooled from the carburizing temperature in such a way as to avoid oxidation as much as possible. It is advisable to cool slowly in the boxes; but if the pieces are of such a size and shape that they can to advantage be removed from the carburizing while hot, they may be quenched at this state. The steel should then be reheated just above the refining temperature of the low-carbon core and quenched in oil or warm water. This gives a fine grain to the core, but leaves the surface with somewhat coarse grain. The piece should then be reheated to a temperature just above the critical temperature of the high-carbon surface and quenched in water. It will then have a very hard surface with the finest possible grain. Generally the surface will be harder than necessary; but by reheating to a temperature below the critical temperature, it is possible to draw the temper, reduce the hardness, and at the same time greatly toughen the piece, while also reducing its brittleness.

[Each of the five factors governing the carburization process is then considered separately in the light of the literature on the subject. A list of the references cited is given by the authors at the close of the paper.]

Composition of the Steel.

The influence of the composition of the steel on the case-hardening process is discussed by many authorities, who agree that the absorption of carbon is favoured by those special elements which exist as double carbides, such as manganese, tungsten, chromium, and molybdenum, and is opposed by those which form solid solutions with iron, such as nickel, silicon, and aluminium. Nickel, while it appears to decrease the percentage of carbon in the case, seems to increase the rate of penetration. Manganese should not be above 0·25 per cent., or else the case will be brittle. Carbon is more rapidly absorbed by low-carbon steels; but if they are used, more carbon must be taken up in order to get the desired percentage. Therefore time is saved by using a medium-carbon steel rather than a low-carbon steel. For general case-hardening, the steel should be tough and show a high elongation, but yet should machine easily. A popular steel for this purpose contains from 0·15 to 0·25 per cent. of carbon and not more than 0·04 per cent. of sulphur and phosphorus. Another very tough steel, and one very resistent to elastic fatigue, contains carbon up to 0·25 per cent., and, in addition to the regular elements, nickel of about 1·25 to 1·50 per cent. and chromium of 0·5 to 0·6 per cent. Either the carbon steel or this low chrome steel will carburize readily by any of the standard methods.

Nature of the Carburizing Agent.

Carburizers may be solid, liquid, or gaseous. Liquid carburizers are the molten cyanides or ferrocyanides, and are used only when a very thin superficial case is desired. Small pieces of metal will be carburized to a depth of 0·001 to 0·003 inch after only a few minutes' immersion in the molten bath. A deep case may be obtained by a long immersion in the bath; but it is generally agreed that the use of a solid carburizing agent is preferable when a deep case is desired. The cyanide is also very poisonous, and is potentially dangerous for the workmen. The solid carburizers have as their essential agent solid carbon. All of them generate a carburizing gas at the temperature of carburizing; and it is this gas, and not the solid carbon, which is the effective carburizing agent. It has been shown that in the absence of gases (as in a vacuum) solid carbon only carburizes when it is pressed firmly against the iron or steel, and that then its action is too slow to be of commercial use.

The solid carburizers may be divided into two groups: 1, Those, such as charcoal alone, or charcoal with barium carbonate, which carburize almost exclusively by the specific action of carbon monoxide; and 2, those, such as bone, hide scraps, or ferrocyanide mixtures which carburize partly through the action of cyanides in addition to the action of carbon monoxide. Those of the second group do not seem to carburize more rapidly than those of the first, but lose their effectiveness much more quickly and are rather more expensive. A mixture of charcoal with 10 to 40 per cent. of barium carbonate seems to be about the best and most satisfactory of the solid carburizers. The barium carbonate slowly decomposes at the carburizing temperature—yielding barium oxide and carbon dioxide. The latter is reduced by the charcoal to carbon monoxide, and the barium oxide on exposure to air at ordinary temperature is changed back to the carbonate:

$$\left.\begin{array}{l} BaCO_3 \rightarrow BaO + CO_2 \\ CO_2 + C \rightarrow 2\,CO \end{array}\right\} \text{at carburizing temperature.}$$

$$BaO + CO_2 \rightarrow BaCO_3 \quad \text{at ordinary temperature.}$$

Calcium carbonate and ammonium carbonate break-up too easily, and the alkali carbonates too slowly, to be as good reagents as the barium carbonate.

The nature of the gases evolved on heating some of these solid carburizers is shown in Table I., taken from the work of De Nolly

Table I.—*Composition of Gases Evolved on Heating Solid Carburizers.*

Composition of Carburizers.

No. 1 Wood charcoal.
No. 2 90 per cent. Wood charcoal *plus* 10 per cent. barium carbonate.
No. 3 70 per cent. Wood charcoal *plus* 30 per cent. barium carbonate.
No. 5 Wood charcoal previously ignited at 1800° Fahr.
No. 7 20 per cent. soot *plus* 40 per cent. gypsum, 40 per cent. potassium ferro-cyanide.
No. 9 20 per cent. animal refuse (hoof, hide, bone, &c.), 50 per cent. plant matter, 11 per cent. soda, 5 per cent. silica brick, 14 per cent. moisture.

Analysis of Gases Evolved.

Sample No.		1	2	3	5	7	9
1560° F.	CO	11·3	28·1	25·3	42·2	29·4	54·4
	H_2	74·0	52·8	57·7	20·0	23·6	34·8
	CH_4	10·0	8·7	8·7	2·0	1·2	1·7
1920° F.	CO	19·6	37·3	56·1	71·7	55·6	36·8
	H_2	73·5	60·0	32·0	15·0	19·2	51·4
	CH_4	0·6	0·9	0·9	0·7	0·9	1·2

* "The Cementation of Iron and Steel"—a book in which Giolitti reviews all his previous articles on cementation. Probably the best book written which treats of the subject from the scientific standpoint.

and Veyret. It will be evident that at the higher temperatures the gases are composed almost wholly of hydrogen and carbon monoxide. Nos. 7 and 9 carburized well when fresh, but lost their effectiveness very quickly. Nos. 2 and 3 carburized as rapidly, held their effectiveness longer than the others, and seemed to be the most satisfactory. It is well known that the effectiveness of solid carburizers is usually diminished after several heatings. When first used there is still some destructive distillation with evolution of hydrocarbons, as shown in Nos. 1, 2, and 3. After the material has been once heated, as shown in No. 5, the amount of hydrocarbon decreases, and the material assumes more nearly the properties of carbon with added mineral matter.

Gaseous Carburizers.

The solid carburizers are to be considered merely as agents for generating a carburizing gas whose active constituent is mainly carbon monoxide. Thus the specific action of carbon monoxide greatly preponderates over that of other agents when solid carburizers are used. The solid carburizer is, therefore, unnecessary, since the gases may be generated entirely independently and then be conducted into the furnace. There are various advantages in this procedure. The solid carburizers in the carburizing boxes may depreciate or change in composition and action; but by the use of a gaseous carburizer a carburizing agent of uniform quality is assured. We may thus not only maintain a constant composition of the carburizing gas, but we can heat all the pieces in the furnace up to the carburizing temperature before admitting the carburizing gas, and thus carburize all pieces to the same depth. There are three types of gaseous carburizers: 1, Carbon monoxide; 2, hydrocarbons; 3, cyanogen and various volatile organic compounds containing carbon and nitrogen.

Carbon monoxide when used alone gives a case which is low in carbon. At 1475° Fahr., the case contains 0·80 to 0·90 per cent. carbon; but at this temperature the rate of carburization and penetration is very slow. At 2000° it gives only 0·20 to 0·30 per cent. of carbon to the steel, but its rate of penetration is very rapid. Thus carbon monoxide alone is a poor carburizing agent. At moderately high temperatures carbon monoxide decomposes partially to form carbon dioxide and free carbon, which free carbon formed combines with the iron. As the temperature increases, the amount of decomposition of carbon monoxide into free carbon and carbon dioxide decreases. However, the rate of diffusion of carbon and also of carbon monoxide into steel increases when the temperature increases; so that it is quite natural that the percentage of carbon in the case should be lower as the temperature gets higher. In the presence of excess carbon, which may be provided by means of a solid carburizer, or by means of a hydrocarbon, the action of carbon monoxide becomes much more satisfactory; and by their combined action, a high carbon case may be obtained at high temperature.

The hydrocarbons are much stronger carburizers than carbon monoxide; and, if allowed sufficient time, they will produce a case very high in carbon. At high temperatures the hydrocarbons decompose—giving as ultimate products of their decomposition carbon and hydrogen. Of the hydrocarbons, methane is the most stable. It is practically unchanged when heated to 1600° Fahr.; and even at 1900° the decomposition is slight, unless accelerated by contact with a porous solid surface. The other hydrocarbons are much less stable than methane. They decompose slowly at about 1500° Fahr., but quite rapidly above 1700° Fahr., and do not require the presence of a contact-surface for their decomposition. At relatively low temperatures a large proportion of their decomposition product is methane; but at higher temperatures they decompose directly into carbon and hydrogen. The hydrocarbons when dissociated deposit carbon on the iron in the form of a scale. This carbon is probably the means by which these hydrocarbons carburize the steel. The carbon from the hydrocarbons other than methane is in the form of soot, and when deposited on the surface of a piece is in intimate contact with the iron, and consequently is a very active and rapid carburizing agent. When methane is used, part of it decomposes at the surface of the iron, and leaves a very hard compact scale like retort carbon; but the other part penetrates into the steel until it is eventually decomposed. Methane is thus more effective than the other hydrocarbons. A larger portion of the carbon of methane gets into the steel than of the other hydrocarbons, but it acts slowly below 1700° Fahr. On the whole, the hydrocarbons are energetic in their action, and produce a case which is high in carbon and which increases in carbon content as the temperature of carburizing increases. When pure hydrocarbons are used, the case tends to be too high in carbon and to have too sharp a boundary; and more satisfactory results are attained if they are diluted so that they do not give a case with so high a carbon content. It has been noted that carbon monoxide gives a case too low in carbon, and that it works better when enriched with a more active carburizer. Thus a mixture of carbon monoxide and hydrocarbon gives the best results.

Cyanogen carburizes very energetically, but gives a case which is high in carbon with an abrupt change between the carburized part and the central core which is not carburized. The case is thus one which is easily split off, and is not desirable commercially. Free nitrogen has no effect except to dilute the carburizer and make its action slower. Combined nitrogen, as in ammonia, combines with the iron or steel to give a nitride of iron, which is very hard and exceedingly brittle. Consequently, such nitrogen compounds are objectionable. Cyanogen is dangerous because of its extremely poisonous nature, and organic compounds containing nitrogen are somewhat expensive. It has been recommended to enrich the carburizer, either solid or gaseous, with sal ammoniac, ammonium carbonate, or other ammonium salt, in the belief that the ammonia aided in the carburization, probably through the formation of cyanogen. It has been shown quite conclusively that the ammonia does not form cyanogen, and that it does not help the absorption of carbon. It does make the steel harder through the formation of a nitride of iron; but it is undesirable because of the brittleness of the nitride, as explained above.

Illuminating Gas as a Case-Hardening Agent.

Commercial illuminating gas consists of a mixture of hydrogen and methane, with smaller amounts of other hydrocarbons, carbon monoxide, and carbon dioxide. It might be thought that coal gas which has been formed in a retort at a bright red heat would not suffer further change at the temperature of the carburizing retort; but such is not the case. The coal gas escapes so rapidly from its retort in the manufacturing process that it never becomes fully heated to the retort temperature; and when introduced later in a slow stream into the carburizing retort it breaks down—the hydrocarbons changing to free carbon and hydrogen, and the carbon dioxide and water vapour present reacting to form carbon monoxide and hydrogen. Any coal gas or carburetted water gas will be a strong carburizing agent.

Kurek has given the results of a number of tests on the case-hardening of a mild steel by illuminating gas. His steel contained 0·09 per cent. of carbon and 0·32 per cent. of manganese; and the gas had the following composition:—

	Per Cent.
Carbon dioxide	1·7
Heavy hydrocarbons	2·8
Oxygen	0·3
Carbon monoxide	9·7
Hydrogen	51·7
Methane	30·7
Nitrogen	3·3

He determined the extent to which the carbon had penetrated by removing successive layers of 0·2 mm. each (0·008 inch) and analyzing each layer for its carbon content. His results with illuminating gas, methane, and carbon monoxide are given in Table II.

Table II.—*Results of Case-Hardening with Various Gases, according to Kurek.*

Carbon Monoxide.

Analyses taken from successive layers 0·2 mm. thick.

Temp.	Time.	Percentage of Carbon in Layer No.			
		1.	2.	3.	4.
1475° Fahr.	8 hours	0·67	0·32	0·28	0·21
1650° ,,	4 ,,	0·55	0·36	0·27	0·25
1830° ,,	4 ,,	0·41	0·31	0·21	0·18
1830° ,,	8 ,,	0·46	0·36	0·36	0·29
2000° ,,	8 ,,	0·28	0·28	0·28	9·22
1300° ,,	4 ,,	0·15	..	..	..
1100° ,,	4 ,,	0·13	..	..	..
	Methane.				
1475° ,,	4 hours	No carburizing		..	..
1650° ,,	4 ,,	1·31	0·93	0·74	0·45
1830° ,,	4 ,,	1·81	1·41	1·26	0·55
	Illuminating Gas.				
1475° ,,	4 hours	0·93	0·35	0·16	0·13
1650° ,,	4 ,,	1·45	1·10	0·79	0·48
1830° ,,	4 ,,	2·18	1·37	1·19	0·95

The rate at which illuminating gas is conducted through the apparatus affects the carburizing. The hydrocarbons are decomposed gradually, and deposit carbon either as a loose soot or a hard scale on the pieces. The hydrocarbons act mainly at the surface, and by means of this carbon deposit. Therefore, to get the maximum rate, there should be a coating of carbon on the surface. As has already been mentioned, carbon monoxide acts most strongly when there is some free carbon present; and, for this reason also, there should be a light carbon deposit on the metal. It should, however, be a thin coat, if the gases are to have a strong direct action; for if there is a heavy carbon deposit, the gases will be partially excluded, and if there is no carbon deposit it indicates either that the hydrocarbons have been decomposed before they have come in contact with the steel or that the carbon is not being deposited on the steel as rapidly as it is being absorbed. A practical operating rule would, therefore, be to run the gas into the carburizing chamber at such a rate that there will be a light deposit of carbon on the iron being carburized.

Carbon diffuses into steel very slowly, if at all, below the critical temperature of the steel. Above the critical temperature, the diffusion increases quite rapidly as the temperature increases. All the carburizers except carbon monoxide produce a greater percentage of carbon in the carburized zone as the temperature increases. The following table showing the effect of temperature is taken from Robin's work. It shows a percentage of carbon at the given depth after carburizing for seven hours in coal gas at the stated temperatures. The original steel contained 0·03 per cent. of carbon.

TABLE III.—*Results of Carburizing Low Carbon Steel for Seven Hours in Illuminating Gas at Various Temperatures, According to Robin.*

Temp.	Percentage of Carbon at Depth of				
	1 mm.	2 mm.	3 mm.	4 mm.	5 mm.
1112° Fahr.	0·051	0·032	..	..	..
1292° ,,	0·096	0·045	0·036	..	..
1472° ,,	0·21	0·105	0·048	..	..
1652° ,,	0·363	0·21	0·057	0·03	..
1742° ,,	0·451	0·219	0·093	0·049	..
1832° ,,	0·579	0·321	0·241	0·152	0·091
1922° ,,	0·594	0·365	0·322	0·212	0·15
2012° ,,	1·522	1·487	1·284	1 147	0·988
2102° ,,	1·637	1·604	1·382	1·330	1·195
2192° ,,	2·364	1·708	1·488	1·437	1·349

The figures in the first column up to 2012° may seem rather low; but it is to be noted that this analysis is not at the surface but at a depth of 1 mm. from the surface. The original steel contained only 0·03 per cent. of carbon, and not about 0·20 per cent. as is generally used for case-hardening.

The concentration of a carburizer may be defined as the quantity acting on each surface unit of the metal in unit time. The concentration of a gaseous carburizing agent may be changed by diluting it with an inactive gas or by changing the gaseous pressure. It is not generally desirable to dilute the carburizers, as this simply makes carburizing slower; but it would sometimes be desirable to increase the rate of carburizing by concentrating the carburizers—*i.e.*, by using them under pressure. Carbon monoxide responds quite appreciably to increase in pressure, but the other gaseous carburizers do not. This can be explained as follows: The equilibrium of chemical reactions tends to change, so that a reaction will tend to relieve the conditions which produce the change. If the pressure is increased, the reaction will tend to proceed in such a direction as will tend to relieve the pressure—that is, in such a direction as will cause a decrease in volume.

$$\underset{2\ \text{Vol.}}{2\ CO} \rightarrow \underset{1\ \text{Vol.}}{CO_2 + C}$$

$$\underset{1\ \text{Vol.}}{CH_4} \rightarrow \underset{2\ \text{Vol.}}{C + 2H_2}$$

$$\underset{1\ \text{Vol.}}{C_2H_6} \rightarrow \underset{3\ \text{Vol.}}{2\ C + 3H_2}$$

A glance at these equations will show that the decomposition of carbon monoxide into carbon dioxide reduces the volume to one-half the original; while in the other two reactions, the decomposition which will produce carbon causes an increase in volume. Consequently the carbon monoxide will carburize faster under high than under low pressure. At 0·6 atmosphere the hydrocarbons carburize a very little slower than at atmospheric pressure; while carbon monoxide carburizes only about 0·7 time as fast.

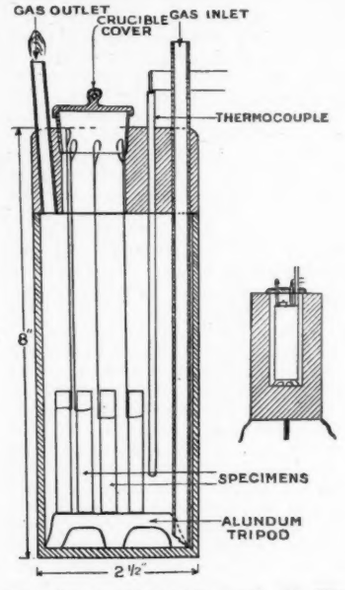
The depth of carburization increases with its duration; and for about two hours the rate of penetration is nearly proportional to the duration. But as the time becomes longer, the rate of penetration becomes slower. This is due to the fact that the carburizers introduce carbon into the surface layers faster than diffusion carries the carbide of iron into the iron. Thus the layers of the surface will be carburized rapidly by the direct action of the carburizer, while the deeper layers will be carburized mainly by the diffusion of carbon or carbide through the steel. Illuminating gas at about 1750° Fahr. will give a case 1-32nd inch in thickness in three hours.

EXPERIMENTAL WORK.

There is some disagreement among the authorities previously cited as to the value of illuminating gas as a case-hardening agent, and the conditions under which it should be used; so experiments were conducted on the laboratory scale (with as much care as possible) to add further data for discussion.

The construction of the laboratory carburizing furnace is shown in the illustration. An unglazed porcelain cup formed the body of the muffle. The top was built up out of alundum cement, with the inlet, outlet, and thermocouple tubes inserted. The upper part of a porcelain crucible was sawn off and inserted to form the charging hole; and the crucible cover was used as the cover. In the bottom of the muffle was placed an alundum table. The specimens, which were about ⅜ inch square and 2½ inches long, were lowered into the muffle on wires, and stood on end on the table so that the gas was spread out and diffused evenly in the lower part of the furnace, and all pieces were exposed on all four sides to the same quality of gas and at the same temperature. The muffle was placed within a vertical electric muffle furnace. It could be heated very evenly, and could be kept within 5° of any desired temperature for a long time. In commencing a test, the furnace was heated about 75° higher than the desired temperature. The current was then reduced to such a value as would just maintain the furnace at the desired temperature and the specimens were put in. The excess heat in the furnace counterbalanced the cooling effect; and the furnace and contents could in this way be brought to the desired temperature in about 15 minutes. After being carburized for the proper length of time, the specimens were lifted out of the furnace by means of the wires attached, and were buried in charcoal, where they were allowed to cool. The charcoal was used to prevent the pieces from being decarburized by the oxygen of the air. The wires used for supports for lifting out of the muffle were, after carburizing, so hard that considerable force was required to bend them. Their hardness was similar to that of piano wire; but they were much more easily broken. In the test where the ammonia was used, the wires were not as strong—only a slight force was required to bend them, and but a very slight deflection was required to break them. The gas used for carbonizing was an unenriched coal gas with a heating value of 600 to 620 B.Th.U. per cubic foot. The gas was passed in at such a rate as to barely maintain a *plus* pressure in the muffle.

By running several different steels at the same time, the effect of the composition of the metal could be determined. By running pieces of steel from the same bar for the same length of time, but at different temperatures, the influence of temperature could be determined. By running pieces of steel of the same composition for the same length of time and at the same temperature, but with a different quality of composition of gas, the effect of the composition of the gas could be found. The results agreed well among themselves, and confirmed the results of previous workers who found illuminating gas a desirable carbonizing agent. The change in composition of the carburized pieces was determined by the usual microscopic methods.



Laboratory Furnace for Case-Hardening Steel with Illuminating Gas.

TABLE IV.—*Composition of Steels Used in Case-Hardening Tests.*

	Mild Steel.	Machine Steel.	Nickel Chrome Steel.
	Per cent.	Per cent.	Per cent.
Carbon	0·04	0·22	0·354
Manganese	0·10	0·44	0·486
Phosphorus	0·007	0·011	0·012
Sulphur	0·029	0·031	0·022
		Silicon	0·169
		Nickel	1·50
		Chromium	0·57

The composition of the steels used is shown in Table IV. Tests were run at 1650°, 1740°, 1830°, and 1920° Fahr. with pure coal gas, and at 1650° with coal gas containing about 6 per cent. of gaseous ammonia. One series of tests was run with a uniform carburizing period of three hours. Since a three-hour treatment at 1850° to 1950° gives a case which is higher in carbon and also rather deeper than is usually required, three more tests were run of shorter duration. One set of pieces was kept exactly an hour in the furnace with carburizing gas on during the whole run, and the temperature ranging from 1830° at the end of ten minutes to 1740° at the end of the hour. The other two were both of one hour and ten minutes duration, and the temperature ranged from 1900° at the end of ten minutes to 1975° at the end of the run. The carburizing gas was turned on at the end of ten minutes, and turned off at the end of forty minutes. Thus the carburizing gas was on thirty minutes, and then the piece was allowed to soak thirty minutes at the high temperature—thus giving the high carbon near the surface an opportunity to diffuse deeper into the piece.

After the test-pieces had been cooled in charcoal, a portion was sawn off for microscopic examination, and the remaining portion subjected to the double-heat treatment usually given case-hardened work. The pieces were placed in the furnace already heated to 1650° Fahr., which is a somewhat higher temperature than is necessary for 0·22 per cent. carbon steel, but was adopted since pieces of the 0·04 per cent. carbon steel were treated at the same time as the set with higher carbon. The purpose

of this heating is to refine the grain of the core; and its duration should be short, and the subsequent cooling fairly rapid, to prevent the crystals from again growing large at the high temperature. The test-pieces, on account of their small dimensions, attained the temperature of the furnace in about fifteen minutes. They were then quenched in oil, reheated to 1475° Fahr., and quenched in water to harden the pieces.

Results of Experimental Work in Case-Hardening with Coal Gas.

The experimental work showed that practically any desired type of case could be readily obtained. The results of a number of different tests made at various temperatures and with differing conditions are given in Table V. [They were also shown in part in a series of photomicrographs.]

Table V.—*Results of Carburization in Coal Gas.*

Designation	Total.	Depth of Case in Inches.			Hardness after quenching Brinnell Number.
		Less than 0·85 per cent. C.	0·85-0·90 per cent. C.	Greater than 0·90 per cent. C.	
Carburized for Three Hours at 1650° Fahr.					
0·04 per cent. C. . .	0·024	0·014	0·010	—	285
0·22 per cent. C. . .	0·028	0·012	0·016	—	444
Ni Cr.	0·030	0·010	0·020	—	555
Carburized for Three Hours at 1740° Fahr.					
0·22 per cent. C. . .	0·035	0·016	0·015	0·003	555
0·22 per cent. C.* . .	0·032	0·023	0·012	0·000	555
Ni-Cr.	0·040	0·016	0·024	0·000	601
Carburized for Three Hours at 1830° Fahr.					
0·22 per cent. C. . .	0·048	0·014	0·012	0·012	601
Ni-Cr.	0·072	0·020	0·052	—	653
Carburized for Three Hours at 1920° Fahr.					
0·04 per cent. C. . .	0·055	0·016	0·014	0·025	601
0·22 per cent. C. . .	0·084	0·033	0·020	0·031	627
Ni-Cr.	0·092	0·023	0·052	0·017	601
Carburized for Three Hours at 1650° Fahr., with Coal Gas Plus 6 per cent. Ammonia.					
0·04 per cent. C. . .	0·030	0·026	doubtful composition because of nitride of iron		321
0·22 per cent. C. . .	0·030	0·024			477
Ni-Cr.	0·028	—			601
Carburized for Thirty Minutes at 1900° to 1975° in Coal Gas and then Allowed to Soak Thirty Minutes.					
0·04 per cent. C. . .	0·030	0·01	0·02	—	—
0·22 per cent. C. . .	0·045	0·02	0·025	—	—
Carburized for One Hour at 1830° to 1740° in Coal Gas.					
0·22 per cent. C. . .	0·02	0·01	0·01	—	—

* Protected by a wrapping of asbestos.

The steel used in the last of these was chrome-nickel steel, and it was carburized three hours at 1650° Fahr. in an atmosphere of coal gas to which had been added about 6 per cent. of gaseous ammonia. The chrome-nickel steel carburizes very much as the plain carbon steel. The added ammonia, however, caused the formation of a nitride of iron, which appeared as a rather granular white constituent on the edge of the piece. The addition of ammonia or ammonium compounds to carburizing agents has been advocated on the ground that a hard case is more rapidly attained by their aid. This practice is, however, objectionable, for the nitride of iron, although hard, is very brittle. This was shown by the properties of the wires which were left attached to the test-pieces while they were being carburized. The wire which was attached to the specimen carburized in gas with added ammonia was scarcely stronger than a straw, while in the experiments where gas alone was used, these wires possessed a strength and hardness similar to an ordinary cambric needle.

Rapid Carburizing with Gas.

It has already been pointed out that not only does the rate of carburizing increase rapidly with the temperature, but that the percentage of carbon in the case increases also. Too high a percentage of carbon is objectionable; and Giolitti's objection to illuminating gas as a carburizing agent is largely based upon this difficulty. If the skin is too high in carbon, and there is not a gradual gradation in carbon content from the outside to the inside of the case, there may be such a difference of expansion that, in extreme cases, the case-hardened skin may split off on quenching. Giolitti therefore prefers, as a case-hardening agent, carbon monoxide which works more slowly and uniformly. A modification in the treatment with illuminating gas which is here described has, however, remedied the difficulties usually experienced in the attempt to use illuminating gas at high temperatures.

The procedure adopted was to place the test-pieces in the retort and carburize with coal gas for a short time at a high temperature—thus producing a thin case high in carbon. The carburizing gas was then shut off and the steel left to soak in the hot retort until the absorbed carbon had diffused itself through a wider area and the case was of the quality desired. It required ten minutes to bring the specimens to the furnace temperature. The coal gas for carburizing was then passed slowly in for thirty minutes and turned off; the pieces remaining in the furnace for yet another thirty minutes to allow diffusion of the carbon toward the centre of the piece. Neither of these pieces showed the high carbon hyper-eutectoid layer which has been an objectionable feature of all attempts to accelerate case-hardening by the use of hydrocarbons at high temperatures.

Summary.

As soon as it was shown that the action of solid carburizers was due primarily to gases which they evolved, and that the deterioration of solid carburizers in practice was due to the emission of these gases, it at once became evident that the use of a gaseous carburizer of proper composition offered the greatest possibility for actual control of the process. Illuminating gas, either coal or carburetted water gas, is a good carburizing agent, and has been used successfully in a number of commercial installations. It has, however, been claimed that it gives too hard and sharply marked a case if an attempt is made to carburize rapidly at high temperature. This paper shows that by case-hardening at a high temperature for a relatively short time, and then turning off the carburizing gas, and allowing the hot metal to soak in the furnace, there will be diffusion of the carbon toward the interior of the piece, and any desired type of case can be obtained. The use of ammonia in case-hardening is not recommended, since a brittle nitride of iron results.

The commercial aspects of case-hardening with gas cannot be treated in this paper. It seems, however, quite evident from the data presented here and in the accompanying paper on "The Heat Treatment of Steel in a Neutral Atmosphere" [as given last week, pp. 138-140] that it will be possible to work out a commercial process whereby the pieces are placed in the furnace, heated in a neutral atmosphere, carburized in gas of controlled composition, and kept hot in an atmosphere of neutral gas until the desired diffusion of the carbon has been obtained. The pieces must, of course, be removed from the furnace for quenching, but will be heated again in an atmosphere of neutral or perhaps slightly carburizing gas for their final heat treatments.

WALLWIN AND SINNATT BURNERS.

For the High-Pressure Air System.

There has been in use commercially for a long time past what is known as the Wallwin system of gas burning by the aid of air under pressure; and in a *brochure* entitled the "Burning of Gas—A New Principle," an explanation is given of the idea underlying the use with it of burners containing perforated dished discs, made under Wallwin and Sinnatt's patent. These discs, concave on the side on which the gas burns, are provided with perforations so arranged that the many streams of already thoroughly mixed gas and air are directed to one common point; and this is the point at which perfect combustion occurs. By making the concavity of the disc greater, the flame may be shortened as desired, until a condition is reached at which the point of perfect combustion is situated quite close to the disc.

It is remarked in the booklet that the flame forms a perfect cone; and no matter how the pressure of the gas is increased, each little stream of gas must pass through the common focus. There is no spreading of the flame, and no unburned gas zone; and each individual stream of gas helps to bring about the complete combustion of the remainder. The many different streams all converging to a point mix and stir up each other and induce combustion. Thus it is the patentees believe the principle to which they draw attention enables them to burn any volume of gas, at any desired rate, and obtain true economy all the time. An explanation is offered of the reasons why it is said to be impossible to effect the result described in the *brochure* by means of a flat or convex disc or gauze; and it is added that, with this burner, the thickness of the metal, the diameter and number of the perforations, and the diameter of the discs have required thought and continuous experiments to ensure success. The principle is one which can be applied to all kinds of fuel gases; the discs in varying circumstances requiring only slight modifications. It should be mentioned that the critical curvature of the discs has been determined for the pressure of air and gas which is used in the system of Messrs. Wallwin and Co., of Salford.

The system must be taken as a whole, as the makers point out that the burners will not work if they are simply attached to an ordinary gas supply. It is particularly suitable, and is claimed to be very economical, for use with soldering irons, tinmen's stoves, brazing burners, metal melting, and other cases where concentrated heat is required; and when large burners are needed, a system of compounding is adopted—a series of discs being so arranged that their flames converge on a common point, and blend into one large conical flame. Should a disc at any time get accidentally damaged, it can be easily replaced in a few seconds. Coming from theory to practice, it is stated by the firm that wherever they have applied this system it has "won golden opinions." Potential users will note that they express their willingness to deal individually with each case, taking into consideration the varying conditions.

Mr. George Waller, of Phœnix House, near Stroud, whose will has just been proved, left estate of the value of £12,881.

THE ASTORIA TUNNEL UNDER EAST RIVER FOR GAS DISTRIBUTION IN NEW YORK CITY.

THE FLOODING AND RECOVERY OF THE TUNNEL.

By HAROLD CARPENTER, Resident Engineer, Astoria Tunnel—Astoria Light, Heat, and Power Company, New York City.

(*Concluded from page* 254.)

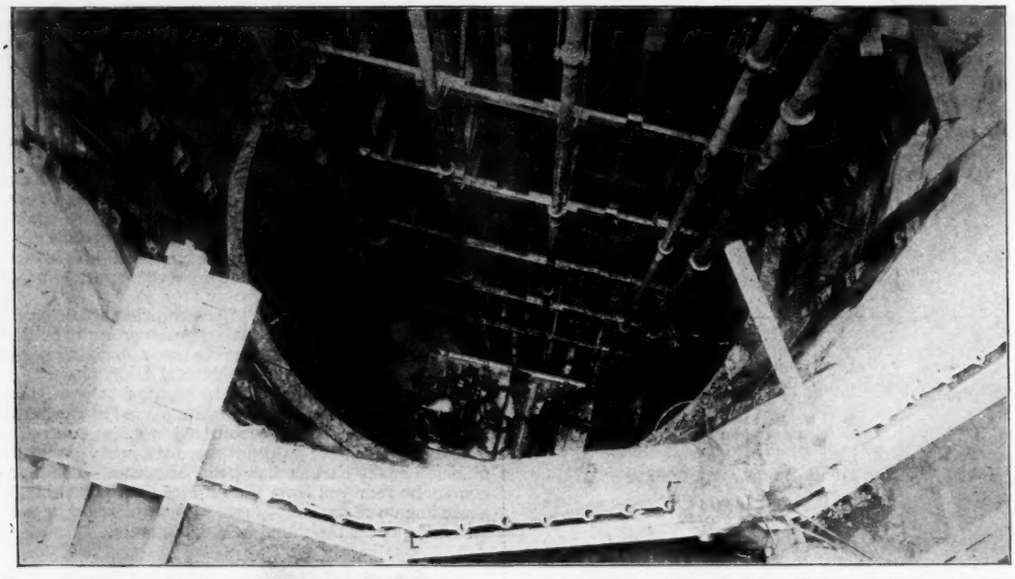


FIG. 5.—PUMPING-OUT THE ASTORIA SHAFT, NOV. 24, 1913. THREE AIR-LIFTS IN OPERATION. THE PUMPS ON THE PONTOON WERE STARTED A FEW HOURS LATER.

PUMPING-OUT THE TUNNEL.

FOR pumping-out the tunnel after the leak had been controlled by filling the entire heading with grout, the following preparations were made: One 1000-gallon and one 800-gallon pump were mounted on a steel pontoon in the Astoria shaft. An 18-inch ventilating pipe and three 8-inch pump discharge lines, which were already in the shaft, were converted into air-lifts by installing small air-lines in them. The three elevators were removed so that the elevator framework could be used to mount additional pumps.

On Nov. 24, 1913, at 7.50 A.M., the 18-inch and two 8-inch air-lifts were turned on. They lowered the level of the water 160 feet by 9 P.M., removing 1,140,000 gallons—an average of 1440 gallons per minute. The 1000-gallon pump was then cut in. As the work progressed, two pumps were used from the pontoon, assisted by the air-lifts, and three 600-gallon pumps mounted on the elevator framing. The discharges of the pumps were connected to the discharge lines already in place in the shaft for the original pumping plant, by means of 6-inch hose; and steam connections were made in the same manner. The bays of the elevator framing were 25 feet apart; and after the water was pumped down low enough so that the three pumps could be shifted, the pumps on the pontoon were used to hold the level of the water while the shift was being made. Conversely, the pumps on the elevator framing were used to hold the water while the connections of the pontoon pumps were being changed.

When pumping began, a gauge on a pipe in bulkhead B [fig. 4, *ante*, p. 253] read 92 lbs.—the figured pressure for this point. In the early pumping this gauge dropped lower than the head in the shaft by 19 lbs. A 5-inch pipe in bulkhead B was opened in order to assist the pumping by using the Bronx pumps, when the gauge began to rise rapidly until it was 24 lbs. higher than the shaft pressure—indicating that the flow was opening-up connection with the river pressure. The pipe was closed, and the gauge jumped to 58 lbs. higher than the shaft pressure.

At 10 A.M. on Nov. 25, the 18-inch air-lift was shut-down—having operated until the water was 200 feet below the top of the shaft, which was an unusual performance, as the air-pipe only extended down a distance of 256 feet. About 2 P.M. the amount of water

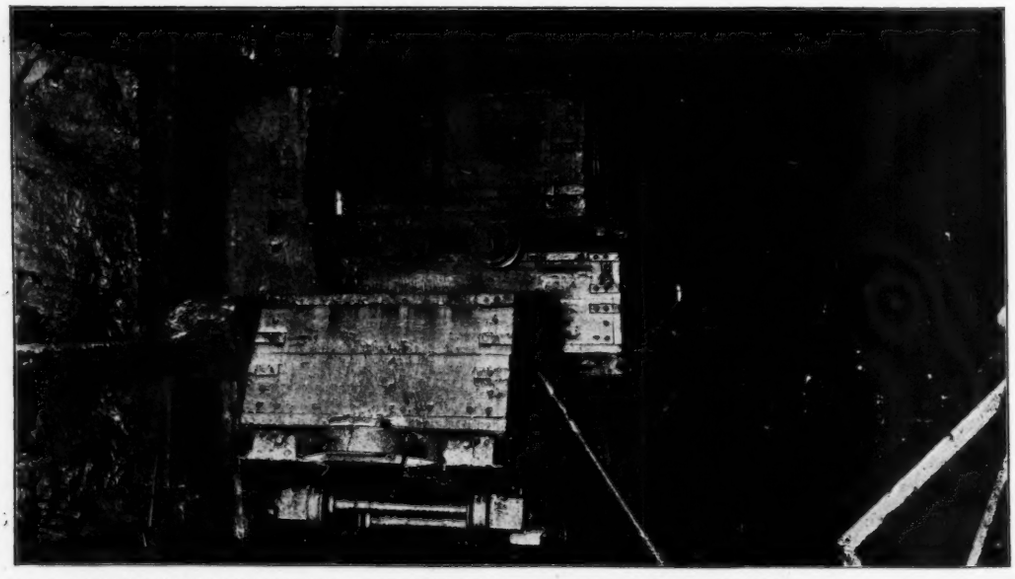


FIG. 6.—CONDITIONS IN THE TUNNEL AFTER THE FLOOD, SHOWING CARS WEIGHING 1800 LBS. EACH PILED-UP BY THE FLOOD OF OCT. 5, 1913.

coming into the shaft appeared suddenly to increase, as if some stoppage had given way in the heading,

On Nov. 26, as the gauge at bulkhead B had been continually dropping, and had apparently lost its connection with the river pressure, the 5-inch pipe was again opened, and the Bronx pumps operated, when the gauge instantly dropped 13 lbs. more.

As the Astoria heading was about 20 feet higher than the Astoria portal, it was feared that a vacuum would form in the heading and cause a rush of water that would swamp the pumps. In looking for a means of forcing air into the heading, a 2-inch pipe in bulkhead B was cleared; and instantly the gauge, which was on another pipe on the opposite half of the bulkhead, dropped another 15 lbs. (to the shaft pressure), and then 3 lbs. more.

The gauge fluctuated—first higher, then lower than the shaft pressure—in a very extraordinary manner. On Nov. 28, when it should have read zero, it read 7 lbs., and continued to do so to the end of the pumping. When the water reached an elevation about 14 feet above the bottom of the tunnel at the portal, the submerged pumps were cut-in. Approximately 24,000,000 gallons of water were pumped.

Vacuum in Heading Holds-back Water.

The attempt to force air into the heading from the Bronx end failed. At 3.30 P.M. on Nov. 28, it became evident that a vacuum was forming in the heading, as the water level had reached a point at that time which it should not have reached until midnight. It was calculated that 1,000,000 gallons were held back in the tunnel above the elevation of the water in the shaft.

An attempt to force air through an air-line which was known to extend well into the tunnel finally succeeded, most fortunately, when the air pressure reached 165 lbs.—evidently blowing out some stoppage, as the air then went in at 35 lbs. Air was then kept constantly on this line, and the lowering of the water proceeded.

The last of the 8-inch air-lifts were shut-down at 11.30 A.M. on Nov. 29, having worked continuously from 7.50 A.M. on Nov. 24. The water was 234 feet below the top of the shaft, and the end of the air-pipe had only 13 feet submergence—an unusual performance for an air-lift.

Entering the Tunnel for Inspection.

At 5 A.M. on Nov. 30, when the water reached a point 4 feet above the crown of the arch at the portal, the air which had been forced into the heading began to break into the atmosphere—bubbling up through the water violently. The pumps were slowed-down, and the escape of the air lowered the water to the level of the portal. The full 100 lbs. of air was then blown into the tunnel to ventilate it. At 7.30 P.M. the water reached a level of 4·5 feet below the crown of the arch at the portal, which meant that it was 13·5 feet deep at the portal, diminishing to nothing at a point 2600 feet from the portal, or 900 feet from bulkhead A. As it was most important to know the actual conditions in the heading, the Engineers' Agent and Resident Engineer manned two rowboats, and (with safety electric lamps) proceeded to the heading—the pumps holding the level of the water. Heavy timber jams were encountered, and had to be cleared away as the boats proceeded. On reaching the face of bulkhead A, it was found that, while the safety door had been dropped as reported, it had jammed on something (afterwards found to be a small piece of wood) and had not closed tight. This, together with the 8-inch drain-pipe, was responsible for flooding the Astoria end of the tunnel. Also, when the heading was pumped full of cement grout, the partly-open door allowed the grout to run out into the main tunnel for a distance of 500 feet. A dam that had been built to hold the drainage water while concreting the invert, stopped the flow of the grout along the tunnel invert, so that the latter gradually formed a bank against the door and finally sealed it off. This bank was from 12 feet deep at the bulkhead to 1 foot deep 500 feet distant; and it varied from fairly well-set cement at the doorway to white mud farther away, through which one had to wade.

The inspection showed that the only leaks in the tunnel were through a 3-inch cable pipe [see fig. 7] and through one of the 8-inch drain-pipes (whose valve had not been closed, as already noted), amounting in all to less than 1000 gallons per minute, with practically no pressure. Through the open drain-pipe and an 18-inch pipe that led away its discharge to a point 1000 feet distant, there had run into the tunnel about 500 cubic yards of green-sand, coal, and refuse. This was entirely separate from the grout. The party reached the shaft again at 9 P.M. The unwatering of the tunnel was completed at 4 P.M. on Dec. 1.

Valves on the Bulkhead Drain Pipes.

On Dec. 3 a trench was excavated in the grout bank to get access to, and control of, the valves on the bulkhead drains, from one or more of which water was flowing. Two of the pipes were found closed, but the third pipe was open and running a part stream. As soon as the valve was moved, water broke out in large volume. The valve evidently had choked with rubbish from the leak and had remained so, fortunately, during the unwatering of the tunnel and the subsequent period. It was most fortunate that the partial stoppage of this pipe did not give way while the inspection party was in the heading on the night of Nov. 30. The condition of this pipe accounted for some of the peculiar and sudden changes in pressures and conditions which had occurred during pumping.

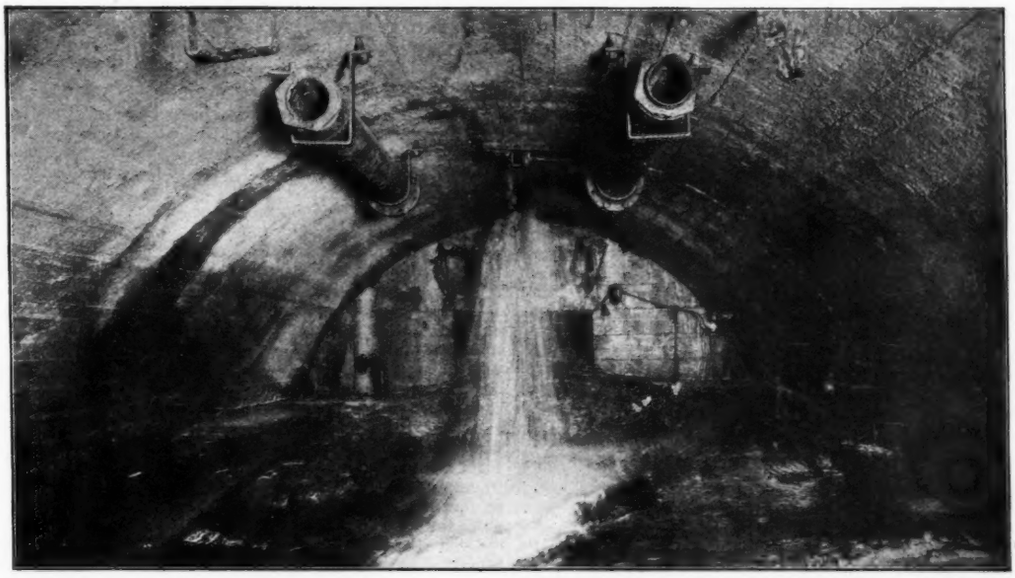


FIG. 7.—BULKHEAD AND GROUT BANK, DEC. 1, 1913. SHOWING THE GROUT BANK WHICH PILED-UP AGAINST THE BULKHEAD DOOR, AND FINALLY STOPPED THE FLOW OF WATER. THE DOOR HAD JAMMED ON A STICK OF WOOD THUS ALLOWING THE WATER AND GROUT TO COME THROUGH. THE DRAIN PIPES ARE 3 FEET TO 4 FEET BELOW THE DOOR.

The large flow caused by disturbing the valve reduced the pressure at the gauge in bulkhead B [fig. 4] from 32 lbs. to 17 lbs., showing direct connection between the two, and indicating also that the source of the leak had not been completely shut off from the river. The valve was then regulated so as not to disturb the pressure between the bulkheads.

In the meantime work had been started on an additional safety bulkhead reinforced with rails, 60 feet back of bulkhead A, for additional protection of the shaft and tunnel. The pumping plant at the Astoria shaft was increased to a capacity of 9800 gallons per minute, which was greater than the boiler capacity.

Final Grouting of the Leak.

On Dec. 16 the drilling of test-holes and core-borings in the side of the tunnel just outside bulkhead A was begun, in an attempt to locate the water-bearing seam, and grout it to shut off the remaining connection with the river. The test-holes were calculated to be only about 20 feet from the seam, and were carefully directed to intersect the line of the seam as plotted from the data available. The core-borings were aimed to reach the seam

FIG. 8.—EXCAVATION THROUGH THE GROUT, JAN. 10, 1914. THE DRIFT EXCAVATED THROUGH THE GROUT BETWEEN THE SAFETY BULKHEADS PLACED TO STOP THE FLOW OF WATER FROM THE FLOOD OF OCT. 5, 1913. THE PIPE ON THE RIGHT IS THE CORE-DRILL ROD THROUGH WHICH THE HEADING WAS FILLED WITH GROUT. THE DRILL HEAD AND 28 FEET OF PIPE WERE REMOVED. THE TIMBER AT THE TOP IS PART OF A STRUT TO BUTTRESS "A."—FIG. 4, *ante*, p. 253.

at a point farther in, nearer the original water hole. About seventeen test-holes and ten diamond-drill core-borings were drilled into the side of the tunnel, and through the bulkhead A into the bench near the water hole.

One of these test-holes, about 22 feet long, on Dec. 17, struck decomposed rock (greensand) and water under the full pressure. It was grouted with 3351 bags of cement under high pressure. Conditions were noted by means of pressure gauges on bulkheads A and B, and by permitting the pipes in bulkhead B to remain open. Grout appeared at once at bulkhead B, showing that the grout-hole was connected to the original leak, and that the latter was still open into the heading. This grouting was effective in stopping the flow.

While the grout was being given time to set, a thorough exploration of the bench and heading was made through bulkhead A by means of core-borings; but no further water was encountered. This work was completed on Jan. 4, 1914—three months after the flood of Oct. 5.

Excavation of Grout from Heading.

On Jan. 5 excavation of the grout from the heading between bulkheads A and B was commenced [see fig. 8]. The bulkhead door was found jammed open by a stick of wood 1 inch thick and 4 inches wide. The door was opened on Jan. 7. A drift through the grout was completed up to the door in bulkhead B, and the door was opened on Jan. 13. The entire space between bulkhead A and bulkhead C was filled with grout, except for some sand at the bottom; and the space between bulkhead C and bulkhead B was filled with grout to within 2 feet of the top. This grout was highly stratified. Some of it was set fairly hard, while next to it would be a layer of grout of the consistency of chalk.

A most peculiar fact was that, while the total amount of cement used in grouting from both ends was only about 600 cubic yards, nevertheless 1200 cubic yards of solid grout was removed from the tunnel and the space between the bulkheads—not to mention the quantity that evidently must have remained in the seams and stopped the flow of water.

This more than doubling in volume of the grout can only be explained on the assumption that cement in the form of grout does not maintain constant volume. The fact that the discharge of sand and débris from the leak was mostly carried 1000 feet away, and kept entirely distinct and separate from the white material, and, further, that this discharge had no white material in it whatever, makes it improbable, in the writer's opinion, that the increased volume was due to a mixture of grout and dolomitic sand from the leak. The discharged material was all very dark in colour, and the sand from seams had always been dark, except in a very few instances when material similar to beach sand had come in.

Most of the grout was poorly set, and was, in fact, largely removed with picks. The diamond bit was found embedded in a block of grout that, in turn, was buried under 4 feet of greensand

FIG. 9.—THE TEMPORARY CONCRETE INVERT ON THE TOP OF THE BENCH BETWEEN THE BULKHEADS "A" AND "C."—FIG. 4, *ante*, p. 253.—JAN. 22, 1914. CONSTRUCTED FOR PROTECTION IN THE EXPLORATION OF THE BENCH FOR WATER BEFORE REMOVAL.

and débris, being completely separated from the main mass of grout. The removal of grout was completed on Jan. 14.

Bench Excavation Resumed Under Temporary Invert.

The top of the remaining bench between bulkheads A and C was trimmed off at 2 feet below the springing line, and a concrete arch invert built over the entire top of the bench, bonded underneath the concrete arch lining. The purpose was to explore with test-holes the entire bench and grout any water seams through the invert arch before excavating. This invert was completed on Jan. 20.

On Jan. 22 the excavation of the 23·5 feet of bench between bulkheads C and B was resumed very slowly, preceded by many test-holes. The drilling of test-holes systematically located was also begun through the invert on top of the bench between bulkheads A and C. On Jan. 27 water and greensand under pressure were encountered in some of the test-holes (just south of bulkhead C) and grouted. On Jan. 31 very bad ground was exposed in the west side of the excavation, between bulkheads C and B; and at 3 A.M. on Feb. 1, water broke out and flooded this section to the springing-line, but developed no pressure. The section was lined with thick concrete walls, draining the water through pipes that were later grouted.

After the top of the bench between bulkheads A and C had been thoroughly explored with test-holes drilled through the temporary invert, three test-hole pits were excavated across the bench and concreted, in order to allow still deeper exploration with test-holes from these pits. In all, 284 test-holes were drilled in the bench between bulkheads A and C.

On Feb. 16 the excavation of the bench in the danger section just north of the Astoria bulkhead A was resumed, and advanced very carefully, and with as little blasting as possible. As soon as each section of about 20 feet was excavated, it was immediately lined with concrete before proceeding farther. The rock of this entire section was very much disintegrated—wet and full of seams.

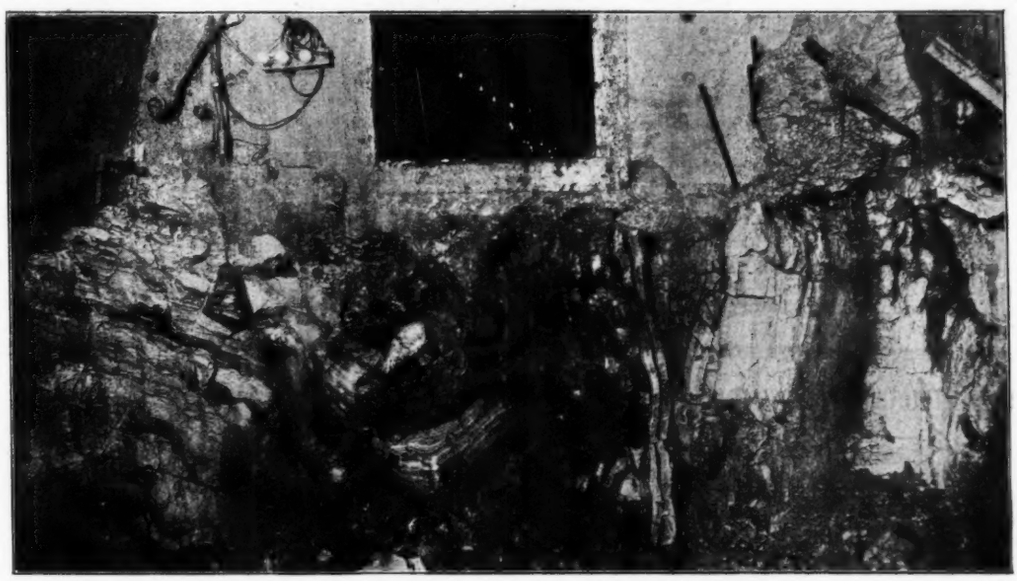


FIG. 10.—FACE OF THE BENCH, SHOWING THE SEAMS AND DISINTEGRATED ROCK, JAN. 30, 1914. LOOKING SOUTH FROM THE BRONX BULKHEAD TO BULKHEAD "C."—FIG. 4—*ante*, p. 283.

Seam that Caused Flood Laid Bare.

On March 2-4, 1914, the second section, 17 feet to 46 feet north of bulkhead A, was excavated. The rock was very bad. The excavation on its westerly side exposed what was undoubtedly the seam that caused the flood on Oct. 5, 1913.

This seam was from a few inches to 2 ft. 6 in. wide, as exposed. Portions of it were filled with refuse exactly like that which came in during the flood, other portions were filled with grout, and still others with a combination of grout and refuse. The west side of the excavation was very bad disintegrated rock and seams of sand and grout. At one point there was a synclinal fold, which changed the stratification from 25° with the horizontal abruptly to the vertical. One seam was grouted solid, 6 inches thick. Several flows of water occurred, during one of which a seam was exposed for an area of 7 feet by 9 feet (apparently a vertical section), and a water-hole washed out 3 ft. 6 in. square. They were stopped by grouting through pipes and drill-holes without unusual difficulties.

The excavation of the bench was completed on March 19, except for a small portion underneath bulkhead A, which could not be removed until June 16, 1914.

Cast-Steel Lining in the Trouble Zone.

It was decided to line 400 feet of the tunnel through the trouble zone with cast-steel rings. Work was begun on this on April 17, 1914, and completed on Nov. 29. During the placing of the steel rings the tunnel and shafts at each end were always kept protected by safety bulkheads; three additional ones being constructed for this purpose. No further flows of water occurred, however. The removal of these bulkheads was completed on Nov. 24, 1914.

In the meantime, the lining of the rest of the tunnel with concrete was going forward. The concrete lining (including the concrete inner lining of the steel rings) was completed on Jan. 10, 1915. The first piece of the 72-inch gas-mains was lowered and placed in position on Jan. 23, 1915. The work of installing the two mains is now [Oct. 1, 1915] nearing completion.

Quantities of Materials: Accidents.

Eight safety bulkheads across the full-section tunnel, and three across the heading, were constructed to protect the tunnel from floods. In addition, thirty-five temporary bulkheads had been built over portions of the heading or bench to confine water for grouting.

The construction of the tunnel involved about 100,000 cubic yards of excavation, including surface and miscellaneous, of which about 90,000 cubic yards was rock. Of this, 39,500 cubic yards of rock was crushed on the job, and largely used in the concrete lining. Concrete placed amounted to 36,000 cubic yards, of which 32,000 cubic yards was for permanent lining. The lining required 200,000 bags of cement; foundations, bulkheads, &c., 27,000 bags; for grouting 118,000 bags were used—making a total of 345,000 bags.

Test-hole drilling to explore for water included 3318 holes of a total length of 43,000 feet. They were grouted with 26,700 bags of cement. And, further, seventeen diamond-drill holes totalling 1500 feet were drilled, consuming 1800 bags of cement in grouting them. For grouting the shaft and tunnel lining, both concrete and metal, 63,000 bags of cement were used. Grouting behind the bulkhead consumed 26,500 bags.

For blasting 195,000 lbs. of dynamite were used, with a record of only one accident from its use, resulting in one death. The coal consumption was 62,000 long tons [up to Jan. 1, 1915]. About 226,000,000 cubic feet of water were pumped out of the tunnel, representing a consumption of approximately 628,000 H.P. hour for pumping alone.

Notwithstanding the extremely hazardous nature of the work, extending over a period of four-and-a-half years, only six fatal accidents occurred, of which only one was due to dynamite, and none to the dangerous conditions due to floods. This is perhaps a unique record of construction work of a similar nature, and is due to the unusual precautions taken for safety.

Inception of Project and Organization.

The credit for the inception and carrying out of the project of providing for the ultimate removal at a future date of all the gas-lamps from Manhattan to a great central plant on Long Island (the Astoria plant) and the conveying of gas from this plant to Manhattan and Bronx by means of tunnels is entirely due to Mr. William H. Bradley, the Chief Engineer of the Consolidated Gas Company, who originally conceived this plan nearly thirty years ago, and, with the completion of the tunnel described in this article, now sees it finally certain of being carried to completion.

The entire work of engineering, organization, and construction was carried on by the Consolidated Gas Company of New York, through its subsidiary—the Astoria Light, Heat, and Power

FIG. 11.—EXCAVATION OF THE BENCH THROUGH THE FLOOD SECTION, LOOKING NORTH FROM BULKHEAD "A" TOWARDS BULKHEAD "C."—FIG. 4, *ante*, p. 253. THE CONCRETE WALL AT THE BACK OF THE MEN IS THE FACE OF ONE OF THE TEST-HOLE PITS CONCRETED TO EXPLORE THE BENCH FOR WATER. ON THE LEFT SIDE OF THE PICTURE IS A PORTION OF THE SEAM WHICH CAUSED THE FLOOD OF OCT. 5, 1913, FILLED WITH GROUT AND REFUSE. MAY BE SEEN AT "A."

Company—under the direction of Mr. Bradley as Chief Engineer, Mr. W. Cullen Morris as Engineer of Construction, and Mr. Harold Carpenter as Resident Engineer—by Jacobs and Davies (Inc.) as Tunnel Engineers—a firm that engineered the Pennsylvania Railroad Hudson River tunnels, the Hudson and Manhattan Railway tunnels, and much similar work in other parts of the world. Mr. Vivian Messiter, as Engineer's Agent, was in charge for Messrs. Jacobs and Davies.

THE NATIONAL COAL INDUSTRY.*

POSSIBLY no better occasion could have been chosen than the present time for the publication of a book dealing authoritatively with the British coal trade from the economic standpoint; for the problems connected with the carrying on of the greatest of our national industries, and the most profitable utilization of its product have—with the exception perhaps of the great coal strike a few years ago—never been more in the public mind. It is pleasing, therefore, to find that the last-issued volume of the "National Industries" series [edited by Mr. Henry Higgs, C.B.] is on this subject, and that the author is Professor H. Stanley Jevons, in support of whose claim to attention it may be stated that he was formerly Professor of Economics at the University College of South Wales and Monmouthshire, "where experience has shown the urgency of coal trade problems."

The growing part which the coal trade and the miners are destined to play in the economy and the politics of this country has always been before the author as defining the object and the scope of his book—which is aimed at giving a popular account of the coal mining industry and the coal trade of the British Isles, with special attention to the economic and social aspects. He foresees that stricter and more extensive legislative regulation of the mining industry will be demanded, and that the nationalization of mines will be seriously proposed and discussed; and it is his feeling that no adequate consideration of such measures by the public or in Parliament is possible while there is widespread ignorance of the modern methods of working coal, the conditions of employment of coal miners, &c. Therefore much information is furnished which bears on this point of view. The facts and figures quoted are so many that their collection and collation must have entailed—as, indeed, Professor Jevons shows has been the case—the expenditure of a great deal of time and labour. There are a number of illustrations—including a coloured map of the coal fields, various diagrams and photographs of coal-mining operations, and charts relating to supply and demand, prices and freights. Not the least useful feature of the book, too, is a bibliography of the coal trade—set out under the heads of descriptive, general, historical, social, trade unions and wages, technical, economic, commercial, annuals and periodicals, and Government publications. The volume extends to nearly 900 pages; so that a complete assimilation of its contents would take an appreciable amount of time. But people desirous of gaining an insight into so complicated a position of affairs as is presented by the conditions governing the coal mining industry, will, so far from begrudging time spent on its study, experience a feeling of thankfulness on finding that they can advance their knowledge so far within the two covers of one book.

From an explanation of coal and coal seams, the reader passes to descriptions of the different fields, the methods of mining and selling coal, and the economics of the trade. Then there are chapters on wages, safety, mining law, and the conditions of life of miners. Some attention is also given to more general questions—the future of the British coal trade, the world's coal resources, and oil fuel. With such an enormous field to cover, it will be understood that Professor Jevons has not attempted to deal exhaustively with any one particular branch of his subject; it is just what he intended it to be—a popular account of the mining industry and coal trade of this country, written by an author well qualified to undertake the task.

* "British Coal Trade," by H. Stanley Jevons, M.A., B.Sc., F.S.S., F.G.S., Professor of Economics at the University of Allahabad. London: Kegan Paul, Trench, Trübner, and Co., Limited. 1915. Price 6s. net.

Provisional Orders for 1916.

The Board of Trade give notice to parties contemplating the promotion of Provisional Orders in respect of gas and water, electric lighting, &c., that, for the duration of the war, they will not be prepared to entertain such applications except in cases in which they are satisfied that extreme urgency exists.

Thomas Hawksley Lecture.—At a meeting of the Institution of Mechanical Engineers last Friday week, Mr. Dugald Clerk, D.Sc., F.R.S., delivered the Thomas Hawksley Lecture; taking as his subject the "World's Sources of Fuel and Motive Power." Dealing with coal, he said that at the present rate of consumption the world's supply would last 5400 years, and that of the United Kingdom for 500 years. Taking all the lines of economy, it was estimated that about 60 per cent. of the coal burned annually might be saved. He dealt also with the development of hot air and internal combustion engines. He described the gas-engine made by the Rev. Mr. Cecil in 1820, and the Lenoir engine (working at atmospheric pressure) of 1862. In 1876 Otto introduced the first compression engine; Mr. Clerk following two years later with a compression engine, and in 1880 with his two-cycle engine.

BYE-PRODUCT COKING AND CHEMISTRY.

By Douglas R. Wattleworth.

In these days of strife, when everyone is calling that Britain shall capture the trade, and especially the chemical trade, of the Germans, it comes as a shock to be told that there are still works in the country engaged in the manufacture of chemical substances at which no chemist is employed. Yet that this is so we have the word of Mr. T. G. Watts, speaking at a general meeting of the South Wales Institute of Engineers last September. We are all more or less aware, from the leaders, not only of our Technical Journals, but also even of our daily papers, that in the matter of chemical research and the co-operation of our universities and industries, we have allowed the German nation to get far ahead of us. There is no doubt that we have at last begun to shake off our lethargy, and look round to see which is the best course to pursue; but in this, as in most other things which we as a nation do, we move but slowly. Let us hope that we shall, however, be none the less sure.

No wonder that some of us are inclined to be pessimistic in regard to our success in the commercial campaign, when such ancient and unenlightened methods as that presented to us by Mr. Watts are still in vogue. Fortunately, such places are very few and far between, and are generally under some old and narrow-minded management of long standing, who look upon a laboratory and a chemist as being unnecessary luxuries, and who are quite confident that their experience is equal to, and even better than, all the analyses and tests and chemical control of the expert. A bye-product coking plant is almost the last place one would look for one of these managers, who are, one might say, a decade or more behind the times. Plants which have been erected in connected with collieries, and where the colliery manager has taken over the management of the ovens, are the places where such men are apt to be found.

Perhaps in no single process is there so much scope for the chemist as in the distillation of coal with the recovery of the various bye-products. This has been recognized to a more marked degree in the gas industry; and much good work has been done, both at the works laboratories and also by many academical workers who have taken up the subject. The major part of all such research has been of great use to the coke-oven world, yet there are many features in the carbonization of coal in the light charges of a retort which differ materially from the conditions arising from the distillation of charges of 8 or 10 tons.

Apart from research work, let us look at the daily routine work of the coke-oven chemist, which is absolutely necessary for the scientific and economical operation of the plant. It is the opinion of the management at a large number of works that any youth may be trained to carry out this daily routine work in a mechanical manner, and thus do away with the expense of keeping a trained chemist. Such men are almost as bad as those who employ no chemical control at all. Of course, if the manager himself is a qualified chemist, and is able to direct the labour of the laboratory worker, well and good; but very often the manager possesses only a very superficial knowledge of chemistry, or else has not the time to attend to the laboratory work personally. Under these circumstances, the shortcomings of the laboratory worker become apparent. The writer knows of large works where several such laboratory assistants are employed, who can make analysis of all the materials in use on the works, and give the most reliable results, and yet do not know sufficient chemistry to understand the simplest reaction which they make use of in their daily work. Of what use is a man like this in the economical working of a plant, if put in charge of the laboratory? None whatever. He may be able to tell with unimpeachable accuracy the percentage of free and fixed ammonia in a waste liquor, or how much volatile matter there is in a certain coal, because he has done the same thing so often that he is expert. Ask him to trace the reason for a fall in the make of sulphate of ammonia, and he is lost. As mentioned before, the daily routine is necessary for the economical running of a plant. There are so many channels open for waste that a very watchful eye is needed; and only the constant taking of samples in the various directions, and the careful testing of them, can possibly lead to maximum productions.

Beginning with the coal-washery. Should more than one class of coal be used, every consignment should be carefully sampled, and the moisture, ash, sulphur, and volatile matter carefully determined. Occasionally, also, the percentage of phosphorus and nitrogen should be found. Those coals which contain chlorides should be regularly analyzed for this impurity. Much useful information may also be gathered by submitting each class of coal from time to time to distillation in one of the many small-scale plants which have been designed for the purpose. By means of this test, figures for yield of coke, tar, ammonia, benzol, gas, &c., are obtained, which, if not the amount recovered in practice, are certainly useful for purposes of comparison.

The refuse from the washery should be daily checked for its content of coal, especially in those plants where ancient and ramshackle washing plants are in use. In the more modern washeries, so steady and reliable is their working that samples twice or three times per week are quite sufficient. The moisture and ash in the washed coal leaving the washery should be estimated daily; also in the coal as charged to the ovens. It is also desirable to test this coal for chlorides fairly often; and the water used in the washery should be periodically examined for the same substances. Samples of coke taken regularly, and the time of charging noted, allow one to trace the passage of coal high in ash or sulphur through the ovens.

Passing on to the bye-product side, there is the working of the ammonia stills and the saturators to check, and the amount of ammonia passing away in the waste liquor and in the gas, to determine. The quality of the sulphate of ammonia must be kept up to the standard, and the cause of excessive moisture or free acid immediately traced and removed.

On coming to the benzol plant, we find even more work still for the chemist, especially if a rectification plant be attached. First, attention must be paid to the scrubbing oil; its specific gravity and the amount of water it contains being determined. This latter particularly should be watched, as a very little water causes a big falling off in the absorbing properties of the oil, besides causing endless trouble in the stills by priming. The oil leaving the coolers after being treated in the still, must be regularly submitted to a fractional distillation test, so that only the minimum amount of benzol shall be left therein.

It is also desirable to test the gas after the benzol scrubbers from time to time for benzol; and though no absolutely reliable test has yet been brought to perfection, yet by adopting a standard method, comparative results may be obtained. Perhaps it would not be out of place to describe the method the writer employs for this test. About half a cubic metre of the gas is passed through nitrobenzene, which possesses the property of absorbing the benzol from the gas, at the rate of about 30 to 40 litres per hour. The nitrobenzene and benzol are then carefully fractionated and the benzol collected in a cylinder graduated in tenths of a c.c. This fractionation is readily affected owing to the high boiling-point of the nitrobenzene (206° C.). In fractionating, the distillate is collected up to 200° C. A little water generally comes over with the benzol; and this is allowed for in the measure. By always using the same method, under, as far as possible, the same conditions, and by carefully noting the temperature of the gas entering and leaving the scrubbers during the test, much information can be gathered as to the efficiency of the scrubbing. Another method is to determine the amount of benzol in the gas before the scrubbers by means of ice-cooled heavy paraffin, and compare the result with the actual yield obtained.

The actual separation of the crude benzol from the absorbing medium, and the keeping of the storage tanks at 65 per cent. to 120° C. requires very careful attention, and frequent distillations of samples of the crude benzol. The whole regulation of the plant here depends on the chemist. No rule-of-thumb methods will apply for telling if the stock is below or above strength.

In the refining plant, the control of the chemist is required almost more urgently than ever. When the crude benzol is fractionated into raw benzol, raw toluol, &c., the distillate must be constantly sampled and subjected to a distillation test, in order to determine the point at which the fraction should be "cut." The washing of the raw products, and their subsequent redistillation for refined products, must also be carefully watched in the same manner, so that they shall conform with the specifications of the buyers, which in many cases are very severe.

The foregoing gives a rough idea of the usual routine work which the chemist of an average coking plant is called upon to do. On top of this, he may have to undertake the examination of endless other things. Among the incidental jobs which often fall to his lot, the following may be mentioned: Analysis of gas, water, fire-bricks and clays, lime, &c.; tests on the waste gases and regulation of ovens; examination of the tar, &c. Where other departments exist—such as oxide purification plants for the gas, water-softening apparatus, &c.—the chemist must watch these as well, as it is only by the strictest chemical control that the respective units can be worked at their highest efficiency.

From this brief *résumé*, it will be seen what enormous possibilities there are for waste and inefficiency to occur. The much-talked-of experience may possibly tell the approximate amount of moisture in a washed coal, but never the percentage of ash. It may give an idea of the amount of free and fixed ammonia in a waste liquor, but how determine the free acid in sulphate or the amount of ammonia in the gas leaving the saturators? The laboratory worker with no chemical knowledge may be able, in a mechanical manner, to carry out all the above tests and analyses; but if he cannot convert the result of his labours into "£ *s. d.*," he is of very little value to his employers. It is on a works like a coking and bye-product plant that the real value of a trained chemist is realized. With so many operations depending upon chemical and physical laws, for their successful working, his knowledge and skill are in constant demand.

So far only the actual daily routine work of the chemist has been mentioned; but what of the research work of which one hears so much nowadays? The great majority of coking plants possess really well fitted laboratories; but one can quite understand that, with so much routine work, and usually only one chemist and an assistant to do it, very little time is to spare for anything further. We talk of submitting our problems to the universities; but experience shows us that up to the present our academicians are not sufficiently intimate with manufacturing conditions to fully appreciate the difficulties they present. The works chemist is the man in daily touch with the operations. He has intimate acquaintance with every phase, whereas university men can without doubt better carry out research work.

It is only to the closest co-operation between the two, then,

that we can look for the future progress of the industry along scientific lines. Since the outbreak of the war, progress in this direction has undoubtedly been made; and there is no reason why we should not only catch the Germans, but beat them at their own game. And yet when we come to think of those plants in South Wales . . .!

SUPPLY OF GAS IN WAR TIME.

NOT THE SAME AS OTHER YEARS.

By A Provincial Manager.

Anyone glancing casually through the Gas Press cannot fail to be impressed with the amount of unrest existing among employees at some gas-works. The reported cases refer more particularly to large concerns, where the representative trade union has a standing; but it does not follow because prominence is not given to the labour troubles in smaller works, that they are without anxiety in this direction.

Since the declaration of war, through the calling-up of reservists, and the enlistment of the medically fit, the labour resources of gas-works have diminished to an alarming extent; and this is felt more acutely in industrial centres where government work is carried on. There has been, and is at the present moment, undue competition in labour circles between firms who are in a position to pay an exorbitant figure for labour. Consequently, many men until recently employed on gas-works are to be seen working for firms who will only require their services as long as the Government finds it necessary to place remunerative contracts with them. Now, when it is taken into consideration that the commodity we supply has become more than ever an absolute public necessity, inasmuch as gas is required to facilitate the execution of much Government work, it is apparent that any undue hampering of gas-works labour resources must have an adverse effect upon the production of the needed commodity, and will ultimately reflect upon the quantity of work turned out by some Government contractors. Competition is looked upon as the life-giving impetus of industry; but it is nevertheless folly to let competition in labour retard the production of the commodity essentially necessary to carry on the self-same important industries.

I mentioned before that there is competition in industrial centres; and I know cases where fitters have left gas-works employ to go to works in the same neighbourhood at a rate of wages equivalent to 40 per cent. increase. Reliable stokers are almost unprocurable; and no matter what advance in wages gas undertakings are prepared to grant, their financial resources sooner or later cannot compete with firms who are, broadly speaking, subsidized by Government. The gas industry is faced with the unpleasant fact that, owing to abnormal circumstances, a large percentage of their more skilled and medically fit staff are either on active service or have gravitated to quarters where pay for the time being is more remunerative. How to meet such a contingency is a problem to be dealt with by many managers in charge of gas-works.

A case in point came forcibly before me. At a comparatively small works situate in a country district, although supplying an area containing manufacturing works, labour became so scarce that the foreman on several occasions had to do stoking for periods of eighteen hours at a stretch, to ensure even a reduced supply of gas being delivered to the district. The management received letters and telephone messages from firms on Government work, dwelling upon the inconvenience experienced owing to restricted pressure or an insufficient supply of gas. At another works, the manager and staff have had to assist in the emptying and refilling of purifiers, so as to prevent foul gas passing to the district. Maintenance of public lamps is sadly lacking in many areas, due to shortness of labour, or to newly-engaged incompetents. Yet, in these abnormal times, it is surprising how little the general public appreciate the fact that gas supply in war is not the same as in other years, and how soon they themselves complain when their light is less brilliant than usual, owing perhaps to temporarily diminished pressure or to a drop in calorific value.

Public bodies all over the kingdom are economizing in public lighting—or, at all events, they are considering the question. I do not at the moment refer to bombardment precautions, but solely to the economic standpoint. Some members of public bodies are prepared to lend their vote for drastic measures in this direction; yet in times past, by these self-same economists, remarks have been made about the danger caused by a single automatic controller failing to act and so illuminate a roadway. Hints are given that gas undertakings do not realize their responsibility in these matters. My comments on these bodies, and on the general public, are not intended as a criticism. I am only endeavouring to explain them under the prevailing conditions.

Very little imagination is necessary for any one to realize that gas supply in war is quite a different problem from the usual running of a gas-works in normal times. A manager has very little opportunity for diversion to-day. His lot is not by any chance an enviable one. He is confronted with labour troubles with a vengeance, and, what is more, the men who are left hold the trump cards. They know it; and they are playing them solely to suit their own ends.

A New Type of Workman.

Many works are finding it almost impossible to replace with efficient men their stokers who are on active service; and in consequence men of inferior type are being engaged. With a growing consumption attendant upon manufacturers busily engaged on war supplies, the difficulty of keeping going is great. Two men have frequently to be employed to do the work of an experienced stoker. In fact, one of these men will not attempt it. This tends to give the regular stokers a somewhat exalted idea of their own capabilities; and the price of their labour rises accordingly. Anything in the way of a war bonus having been granted months ago is apparently lost sight of; for they look on this as their due, consequent on the rise in the cost of provisions. If they are not humoured in every conceivable way, good results are not forthcoming. Many managers can endorse my statement that the make of gas per mouthpiece is sadly lacking if supervision is not constant. An experienced carbonizer can tell almost for certain that a number of the retorts charged during the night shift have only had one-half of their contents withdrawn, and then been recharged. There is, nevertheless, plenty of overpulling taking place. The culprit is known to the manager; but any severe handling or remonstrance on his part would only place additional responsibility on his own shoulders. A reliable and loyal retort-house worker is at the present moment a prop to many smaller undertakings.

The high price of commodities is the pleaded excuse for the advanced rates of wage in almost every case. No one will dispute the justifiable grounds of the application; but there are very few concerns which have failed to grant some concession to assist the workmen to tide over an extraordinary period. I am inclined to the belief that the average type of workman referred to in this article does not intend to make any sacrifice in these troublesome times, if he can possibly avoid it.

Where does the trouble lie? It is not by any remote chance local. The germ of discontent has eaten its way into every corner of the British Isles. Is the attitude prevailing among the mass due to the outcome of our advanced system of education? If so, it appears that their learning has only sufficed to make them take an unfair advantage of a serious position, to the detriment of the suffering community. Education should go further—or, at all events, its results should inspire a deeper feeling of loyalty, and so strengthen our nation to bridge-over a period that will be handed down to posterity as a paramount example of a fight for liberty and freedom against great odds.

The Actual Sufferers.

There is one section of the public which receives little or no sympathy when the profit-making resources of an undertaking are practically non-existent. That section is the shareholders. Most gas companies have at least a few shareholders whose savings have been invested, and who are almost dependent upon the yield of interest for life's sustenance. These people are the real sufferers under war-time conditions. They often have no means of supplementing their reduced incomes to meet the bad days; and they, too, in common with others, have to meet the increased costs of living.

A Higher Standard of Conscientiousness Required.

One can seldom get another man to see his own faults in the same light as they appear to you. I take it we all feel that we know some men better than they know themselves. Be this as it may, the exigencies of the present situation unquestionably call for a higher moral standard of manhood from the men remaining at home. I do not for a moment infer that this applies to everybody. In fact, if each man analyzes himself he will be most willing to admit that the statement applies to others more than to himself.

An opportunity has arrived; there is a golden chance for the second-raters to become winners, if they will only put their shoulders to the wheel and keep it going. There never have been more opportunities to come out top; and the reward attendant on the results is infinitely greater than ever before. The betterment of man must come from within. The desire to conquer is a fight to be undertaken individually. Much has been said about the influence of capitalists, trade unions, the drink question, &c.; but, when all these are simmered down, it seems palpably clear that each man must plough his own furrow, and his desire to improve will best act as his own incentive.

If the second-raters would only rise to the occasion something truly great would be accomplished, anxiety would be relieved in numerous cases, and, what is more, the result would have a far-reaching effect upon our nation as a whole.

Midland Junior Gas Association.—In consequence of prevailing circumstances, the Association are this year arranging for a very much shorter programme than usual. There will be only two or three meetings for the session; and the first of these is to take place next Saturday, when there will be a short opening address by the President (Mr. F. J. Ward, of Knowle), followed by a lecture (illustrated by lantern slides), by Mr. E. Stroud, the Chief Engineer of the Holophane Company, on "Modern Illumination as Applied to Gas Lighting." At the conclusion of the lecture, the meeting will be thrown open for informal discussion.

SIXTY YEARS AGO.

From the "Journal" for Nov. 10, 1855.

Encouragement of Inventions.—We are not disposed to diminish the claims of inventors. Nay, we would even hold, with Sir David Brewster [Sir David Brewster, in a discussion at a meeting of the British Association, had maintained, not only that patents should be given gratis, but that a bounty should be paid by the Government for every invention, however seemingly fruitless], that not only ought they to have patents granted to them gratuitously, but that they ought also to be rewarded for their inventions. But we are stopped at the threshold by the practical difficulty of determining who is an inventor. Among the numerous applications for patents that are every week announced, it is quite evident, on merely looking at the titles of the alleged inventions, that in the many improvements said to have been made in the same thing, there must be several that are very similar, if not identical; and if any class of specifications be examined by persons conversant with the progressive advancements made and attempted in that particular branch of manufacture, it will generally be found that the supposed inventions are either repetitions, in ignorance of what has been previously tried and found to be useless, or else fraudulent modifications of the inventions of others. Among the many provisional specifications of inventions connected with gas lighting, for example, which appear in every number of the "JOURNAL," we may venture to assert that very few, if strictly examined, would be found to possess much claim to novelty. Most of the inventions claimed, indeed, only profess to be "improvements" of some known apparatus or process of manufacture; and it frequently requires very nice discrimination to determine whether such improvements merit to be called inventions. Even in cases where real improvement is effected, it often happens that the advantage gained is produced by means so simple and almost self-evident, that it does not deserve to be placed in the same category with an invention depending for its successful operation on the new application of a scientific principle. In endeavouring, therefore, to reward inventors, and to encourage useful inventions, the first thing required is to ascertain whether the claimants of patents deserve the name of inventors; and, if so, what are the relative merits of their inventions. . . . What is really wanted, for the sake of inventors as well as for the public interest, is the restriction of the number of patents to those only who may deserve them, rather than an increase. When the claims of the meritorious have been ascertained by careful and impartial examination, then let the patent be granted as a reward for ingenuity and scientific acquirements, to be held in estimation as an honorary distinction, instead of being considered, as at present, merely as a purchasable commodity, procurable by any who will pay the fees.

The opening meeting of the one hundred and sixty-second session of the Society of Arts will be held on Wednesday of next week, Nov. 17, when an address will be delivered by Mr. Dugald Clerk, D.Sc., F.R.S., the Chairman of the Council. The subject of the address will be "English and German Methods Contrasted." The chair will be taken at 4.30 p.m.

On Monday of last week the death occurred, at his Newbury residence, of Sir Arthur William Rücker, F.R.S., D.Sc., aged 67. He was one of the Metropolitan Gas Referees from January, 1892, to December, 1896, having succeeded Professor Tyndall, and was followed by Professor Boys. He was President of the British Association in 1901, having previously been Treasurer for seven years. He was also President of the Physical Society from 1893 to 1895, and Secretary of the Royal Society from 1896 to 1901. Among his other distinctions was that of Doctor of Science in the Universities of Oxford, Cambridge, Victoria, Leeds, and Belfast; while Glasgow and Edinburgh both conferred on him the degree of LL.D.

We are informed that Messrs. W. A. Schultz and Co., of No. 50, Cannon Street, E.C., have opened an additional office at No. 5, Victoria Street, Westminster, for the convenience of their clients connected with statutory undertakings. Mr. W. A. Schultz, J.P., F.C.A., who is the principal, has been connected with gas undertakings for the past thirty-two years, and is well known as an expert on gas accounts. It may be remembered that he specially distinguished himself in the firm attitude he took up on behalf of several gas companies in claiming an allowance from income-tax assessments for wear and tear of gas and water plant. It was due to his unflinching position in opposition to the Surveyors of Income-Tax that he was successful in every case in obtaining a favourable decision before the Commissioners of Taxes, with the result that negotiations were opened with him and continued under the auspices of a Committee appointed by representatives of the gas industry convened and presided over by Sir Corbet Woodall, when an arrangement was come to under which the companies are at present working. It is also largely due to Mr. Schultz's initiative that many gas companies are now able to secure parliamentary powers for both gas and electricity—these having first been obtained and put into operation by the Ascot Gas and Electricity Company, of which concern he has been the Secretary for a number of years.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Government Scheme for the Organization and Development of Scientific and Industrial Research, 1915.

SIR,—The proposal to establish a permanent State-aided organization for the promotion of scientific research, with a view to its application to trade and industry, is a most hopeful sign of the times, and will be welcomed in principle by scientific workers generally. But, inasmuch as any such scheme necessarily implies a certain amount of State control and direction of scientific research, and ultimately also of the large body of scientific workers who will be brought within its ambit, there are certain important matters to be considered and settled in principle at the outset, if the scheme is to be as fruitful and successful as it ought to be. I venture, therefore, in the spirit of a friendly critic and well-wisher to the scheme, to submit to your readers the following paragraphs embodying some of the points which seem to me to need very careful consideration, in order that the freedom and interests of individual scientific workers shall be sufficiently safeguarded and conserved.

(1) In my opinion, what is most needful in this country for the development of scientific research in relation to industry, is a central fund for the subsidizing of a limited number of important lines of investigation initiated and carried out by scientific workers and technologists of repute who are, or have been, sufficiently in touch with practical affairs as to have acquired at first hand a real knowledge of industrial conditions, and of the economic factors, which will necessarily come into play in connection with any new development. These proposals might be initiated either by individuals so qualified or by any group or association of such individuals; and such persons should have a strong (if not a majority) representation upon any Advisory Council or Committee appointed either to select or recommend suitable subjects for investigation, or to advise in connection with the prosecution of any investigation so selected.

(2) The selection of a particular line of research should be governed by these considerations mainly:

(*a*) Its importance and practicability as directly bearing either upon the development or revival of national industries, and particularly of those which, although producing essential commodities—*e g.*, synthetic dyes or optical glass—have through past neglect become localized abroad, or which may be conceivably threatened in the near future, or upon questions pertaining to the future better utilization of national resources of raw materials—*e g.*, coal and its bye-products.

(*b*) The probability of there being a successful issue of the investigation within a reasonable time.

(*c*) The fact that its inauguration and continuous successful prosecution would involve expenditure beyond the financial resources either of an individual investigator (even though he may be aided by grants from the existing research funds of scientific and technical societies) or of the institution in, or in connection with, which he may be working.

(3) Broadly speaking, there are three distinct classes of investigation which would come within the above category—viz.:

(*a*) Investigations whose object it is to establish new or more accurate scientific data, or methods involved in the design of industrial appliances or plant, or in the daily scientific control and supervision of important manufacturing processes.

(*b*) Investigations whose object it is to effect some modifications in the details of an existing process whereby it shall become technically and commercially more efficient.

(*c*) Investigations whose object it is to convert a scientific discovery (or results which may be predicated from research in pure science) into a useful scientific invention.

(4) While all the above three classes of research are, or should be, essential features in any organized scheme for the benefit of trade and industry, the third class is undoubtedly not only the most important of all, but also the one which presents the greatest executive difficulties in procedure; and unless at the outset these difficulties are both clearly recognized and equitably met, the complete success of the scheme will be seriously jeopardized.

(5) It ought to be recognized in principle that an individual scientific investigator who may seek or obtain assistance from the central national research fund should be accorded the fullest credit and protection for the ideas which he may disclose, as also direct personal access (without having to invoke the aid or interest of some intermediary person or association) to the Advisory Council or Committee, or persons representing them, administering the fund. Furthermore, if the ideas or discoveries disclosed by him are deemed important and worthy of support, as likely to result in a useful invention, not only should the further investigation of the matter be entrusted to his unhampered direction, but also, in the event of such further investigation under his direction ultimately resulting in a useful invention, his rights and interests in the commercial results of such invention should be equitably provided for and ensured. To the objection which may be made that the acceptance by a scientific worker of assistance from a public fund for the development of his ideas or discoveries implies forfeiture on his part of any pecuniary advantage which would otherwise accrue to him, it may be replied that a scientific worker ought not to be put into a worse position in regard to the development of his discoveries, merely because he is financially assisted by the State, than he would have been had he been financed privately. It is a just and necessary principle in the development of inventions—no matter whether such development is financed by the State or by some private person or syndicate—that the inventor *qua* inventor is as much entitled in equity to a reasonable interest in the commercial results of his ideas as is the financial power that he may invoke; and unless this principle

is conceded at the outset in connection with the Government scheme, it will never attract, or be invoked by, the scientific inventor for the development of his ideas. In short, invention and discovery, being essentially "individualistic" products, cannot flourish or be fully developed on a "socialistic" basis; and in every State-aided scheme there lurks the socialistic danger.

(6) If the above principle be conceded, there are doubtless formidable difficulties in carrying it out. Thus, for instance, it will be necessary to provide that the communication of an idea or discovery of an individual or group of individual scientific workers to an Advisory Board must not merely be confidential, but shall also confer the same sort of provisional protection which the lodging of a provisional specification at the Patent Office now confers. In the second place, should the further State-aided investigation of the matter result in a useful invention, not only ought the resources of the British Patent Office to be freely placed at the disposal of the inventor for the adequate protection of his invention, but also steps would have to be taken to ensure the same protection in all important foreign countries. For unless this were done, foreign manufacturers and countries would reap the reward of British scientific invention financed by the British taxpayer, without having to pay so much as a single halfpenny by way of royalties to the British people, and Great Britain would for ever sacrifice a most fruitful source of "invisible exports" in the shape of "British inventions." Moreover, it might easily happen that an idea or invention originating in Britain, under a Government scheme without due safeguard, might be freely imported into Germany, and, through German sources, be patented in other countries for the benefit of Germany. Such things have happened in the past under the existing patent laws, and will happen all the more in future, if the new scheme does not fully protect British scientific inventions. There thus lurks in the new scheme the serious danger of its proving an instrument and organization whereby British brains and capital will be exploited largely for the benefit of the foreigner; and while this danger may perhaps be minimized by wise foresight, it is inherent in the scheme, and it is difficult to see how it can be entirely eliminated.

(7) The foregoing considerations do not, of course, apply to the first of the three classes of investigations cited in paragraph (3); but unless they are frankly recognized and fully met at the outset, the utility of the scheme in regard to the important third class of investigation will be nullified.

The above suggestions are offered as an individual expression of opinion, which is the outcome of the writer's experience in connection with the development of his own inventions, in the hope that the final scheme will be so framed and safeguarded, in the common interests both of scientific invention and of the British public, that it may be of the utmost benefit to all concerned.

WILLIAM A. BONE.

Imperial College of Science and Technology, London, S.W., Nov. 2, 1915.

Home Sales of Sulphate of Ammonia.

SIR,—We have pleasure in enclosing copy of a circular-letter on the subject of "Home Sales of Sulphate of Ammonia," which the Association has sent out to makers, and which you will probably wish to notice in your next issue.

A. DAWSON, Secretary,
Sulphate of Ammonia Association.

84, *Horseferry Road, Westminster, S.W.,*
Nov. 6, 1915.

[ENCLOSURE.]

With reference to recent correspondence, you will remember that we held a meeting of manufacturers of sulphate of ammonia, as a result of which we offered to guarantee the Board of Agriculture a supply of 8000 tons of sulphate of ammonia for October-December delivery at a price not exceeding £15 per ton, bags free at works, net cash.

Officials of the Board had previously led us to understand that this quantity and price might be regarded as satisfactory; but the recommendations of the Departmental Committee appointed by the Board to consider food supplies and other circumstances, necessitated a change of views regarding both quantity and price. Negotiations were therefore reopened, and culminated in a joint meeting of both Committees of the Association, at which the Right Hon. Francis Acland, M.P., attended and explained the Board's views.

After a full discussion, during which manufacturers representing all branches of the trade clearly and forcibly pointed out the large increase in the costs of production, the meeting unanimously agreed that it was desirable that up to 16,000 tons of sulphate of ammonia should be reserved by makers for November-December delivery, to be sold to farmers or factors at not over £14 10s. per ton f.o r. makers' works, single bags free, net cash, for lots of 10 cwt. and upwards, and that all manufacturers making 50 tons per annum and over should be required to reserve their proportion of this quantity at not over this price. Makers who do not supply bags should allow buyers 5s. 6d. per ton.

Owing to the extraordinary conditions now prevailing, the total make of sulphate has been considerably reduced, and it is now estimated that, in order to provide a total of 16,000 tons for November-December, it will be necessary for every maker to reserve about 25 per cent. of his production—or, in other words, a little over one week's make—for each month.

Each maker will receive a letter from the Board of Agriculture which will provide him with a legally valid excuse for withholding delivery on existing contracts, in case he cannot provide his quota out of the unsold portion of his make.

Each maker will be at liberty to deliver on contracts previously made, or to sell for export or to manure mixers, at the end of each month, the unsold portion of his quota—*e.g.*, a maker whose production for November is 100 tons must reserve 25 tons until Nov. 30. Suppose farmers or factors buy from him 13 tons during November at £14 10s., the maker may, after Nov. 30, dispose of the balance of 12 tons on old contracts or sell it at market price. The same applies to December.

The Board of Agriculture is issuing immediately a pamphlet recommending farmers to use sulphate on autumn wheat; and the object of this arrangement is to provide them with sulphate at a reasonable price. Farmers will no doubt generally prefer to buy, as hitherto, through factors or merchants; and sulphate makers should therefore exact a guarantee from merchants to whom they sell that the sulphate is to be delivered promptly to the farmer.

The Board will not recognize sales for November-December delivery to manure mixers or others who intend to store sulphate to be sold in the spring as a discharge of sulphate makers' liability under the above arrangement.

The factor or merchant will be entitled to charge a fair profit to the farmer; the sulphate maker will be at liberty to sell to factors and merchants at less than £14 10s. if he so desires.

As regards spring delivery, makers are free for the present to sell at the best prices they can obtain; but it may become necessary for them to reserve for home use, in the manner explained above, a monthly quota, which may be expected to amount to about 50 per cent. of their make for January-April.

In order to cause as little inconvenience as possible to overseas buyers, makers who are largely sold are recommended to give export merchants immediate notice that they may have to curtail deliveries on contract.

Those who have already sold part or all of their make for November-December to factors or farmers for home use should give particulars in their reply to the Board of Agriculture's letter, in order to secure exemption from the above provisions.

In conclusion, we wish to say that we consider this arrangement fair to all parties. By it we avoid the calamity of a total prohibition of exports, and we provide the required quantity with a minimum of inconvenience to the export trade and ourselves. Although the price represents a sacrifice to most of us, we feel we are securing in return the best possible advertisement for our product.

We therefore ask all manufacturers to co-operate loyally to carry out this arrangement, the success of which will vitally affect the whole future of British sulphate of ammonia.

(Signed) D. MILNE WATSON,
Chairman of the Association.

Nov. 1, 1915.

Advantages of Sulphate of Ammonia.

SIR,—Referring to the paper I read at Liverpool last year before the Institution of Gas Engineers, I pointed out the advantages of applying to the land sulphate of ammonia combined with other artificial manures for the production of mangold wurzels, and gave several examples of experiments that have been made, the largest of which produced the following result:

Tonnage per Acre.	Value per Ton.	Value per Acre.
57 tons 10 cwt.	12s. 6d. ..	£35 18s. 9d.

Gas engineers generally will be glad to know that, by an increase of sulphate of ammonia per acre costing about 10s., the same kind of crop has been enormously increased.

The judges have again weighed the results from this year's crop, and state that the production per acre is as follows:

Tonnage per Acre.	Value per Ton.	Value per Acre.
91 tons 5 cwt. 80 lbs. .	15s. ..	£68 9s. 4d.

The roots are of excellent quality; and these results have been awarded prizes in the district.

This year we have also applied sulphate of ammonia with other artificials to cabbages, which have turned out very satisfactorily—producing, according to the judge's award, the following result: 59 tons 2 cwt. 96 lbs. per acre.

For other crops on the farm, an increased quantity of sulphate of ammonia was employed, producing better and even more encouraging results than the previous year.

This is an object-lesson for some of the slow-moving farmers, whom at the present time the Government are trying to arouse to increase their crops both for their own and the country's advantage.

JOHN WEST.

Southport, Nov. 5, 1915.

The Late Professor Lewes.

SIR,—As one who attended very many lectures by that Prince of Lecturers, the late Professor Vivian B. Lewes, may I express the pleasure it gave me to see, in your account of the funeral, special mention of his faithful assistant or demonstrator "Joe."

I think it may safely be said that Professor Lewes's experiments were invariably a success. There was never, in a single instance, so far as my recollection serves me, a failure. How much of this success was due to his faithful assistant, we may never know; but certain it is, a better demonstrator could not exist. Every piece of apparatus was precisely in the right place, and brought forward at the exact moment it was required. Never a moment to wait—never the slightest confusion—never an experiment which did not "come off."

GAS ENGINEER.

Nov. 3, 1915.

Gas Company's Show-Rooms.

SIR,—The suggestions by Mr. Cyril G. Davis in your last issue, of how a show-room should be designed, fitted up, and conducted, should be most carefully read by all interested in this important subject. We in the North, certainly, have all three sorts—viz., good, bad, and indifferent.

I agree that show-rooms should not be expected to show a direct profit; but, when conducted on thorough lines, they are undoubtedly one of the best forms of advertisement.

Any who are contemplating show-rooms, or are bringing present ones up to date, would do well in sending those who are directly responsible to see the Davis Gas-Stove Company's most elegantly designed and furnished show-rooms in Oxford Street.

I congratulate Mr. Cyril Davis not only for his most opportune article on this really important subject, but also for the splendid

arrangements achieved by his firm in this direction, and for which I understand he has been chiefly instrumental in having had carried out. I also congratulate the firm upon their courage in such rapid advancement.

WILLIAM D. HELPS.

Leeds, Nov. 6, 1915.

SIR,—May I as a gas engineer be permitted to express my appreciation of Mr. Cyril Davis's excellent article upon show-room reform, which you in your leading article have so ably supported?

Mr. Davis has, without doubt, written upon a subject which behoves many gas managers to study. I would not venture to give an opinion upon the matter had I not visited the salons in Oxford Street, and compared them with the different show-rooms of various gas companies in other towns. The latter have impressed me mostly with their dirty and untidy appearance; their inartistic posters on walls; lop-sided fittings; and bad ventilation. What must be the opinion of consumers after leaving such depressing places? I would not like to express an opinion of the salesmen or those in charge; but it is obvious there is room for improvement without incurring additional expense.

Mr. Davis has evidently placed before us facts of his own experience; and I suggest that his pioneer article should do much to remedy the existing state of affairs and rouse the gas industry to a full sense of its show-room responsibilities.

JOHN MITCHELL.

New Southgate, Nov. 6, 1915.

Gas Testing in the City of London.

SIR,—I have just had my attention called to the announcement in your "Personal" column of the last issue of the "JOURNAL," and would feel obliged by your correcting the same in an early issue. The fact is that I am simply taking charge of the City Gas Examiner's Office, and the testing places, under the instructions of the Chairman of the Committee for County Purposes, pending any arrangement that may be made by the Court of Common Council.

W. W. DUFFIELD.

Lower Whitecross Street, E.C., Nov. 6, 1915.

REGISTER OF PATENTS.

Preliminary Cooling of Incandescent Coke.

WALCH, W., of Düsseldorf, Germany.

No. 17,236; July 21, 1914. Convention date, Nov. 3, 1913.

The inventor proposes to make use of a method of cooling coke (from coke-ovens) which is based on the recognition of the fact that it is possible to deprive the coke of heat by means of gases which prevent combustion and are caused to pass through the incandescent coke—inert gases.

To enable large quantities of heat to be taken up in this manner, the patentee remarks, it is necessary to cause large quantities of gas to pass through the incandescent coke, which involves the expenditure of considerable work on the centrifugal blower, while, unless arrangements are made to employ cheap gases, the method would be rendered unprofitable. The cheapest cooling gases which can be employed for the purpose are the products of combustion of heating plant, and more especially the products of the coke-oven itself, as they escape from the heating passages. The large amount of work required for the centrifugal blowers is balanced by the fact that the method in question is combined with useful heating processes by means of which the heat taken up by the gases during the cooling of the coke can again be beneficially utilized—it may be, in the operation of heating the coke, or it may be for the production of steam or the preliminary heating of air or the like. For various reasons it is advantageous, he says, to cause the inert gases to move in a closed circuit in such manner that they take up heat from the incandescent coke and then again part with the heat to heat-exchanging or heat-consuming apparatus. The use of a closed circuit, it is claimed, has the advantage that the inert gases, when acting as heat-conveyors, will very soon lose the last remnant of their oxygen by combustion; while, moreover, the only loss of heat which can occur in a closed circuit is that due to radiation. The heat of the coke is thus taken up by means of a current of inert gas, whereby it is transferred to a heat-exchanging apparatus—the inert gas preferably consisting of the combustion products such as the heating gases of the oven.

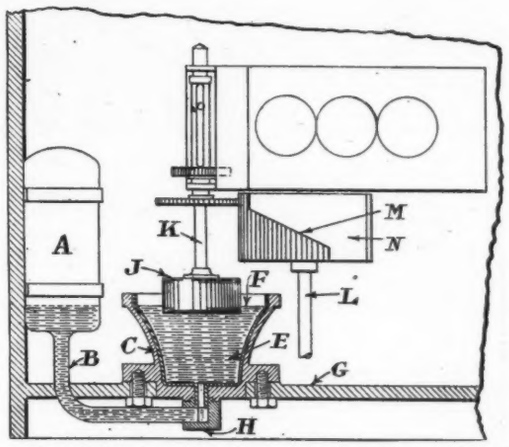
Measuring or Regulating the Flow of Gases or Recording Changes of Pressure or Temperature.

MARSH, R. G., of Birmingham, and WALTER, C. M., of Four Oaks, near Birmingham.

No. 22,687; Nov. 18, 1914.

In explanation of their invention, the patentees remark that, for the purpose of compensating for the variation of the volume of any gas being measured, caused by differences of pressure or temperature, it has been proposed to employ a vessel containing air, which will vary in volume in the same ratio as does the gas, with a stem from the vessel formed into a U tube containing mercury, which will alter its level in the outer arm as the air in the bulb expands and contracts. This movement of the liquid it was proposed should be utilized by employing a float upon it for moving a compensator rod controlling an intermediary conical wheel or integrator in a recording train, to which motion is given by the gas to be measured. They are not aware that this principle has ever been successfully carried out commercially for gas-meters or for pressure-recording or indicating devices—possibly due to the fact that the movement of the float for any increases of pressure, while relatively large at first, becomes considerably less as the pressure increases, until the movement becomes so small as to render it almost impossible for compensation devices in the recording mechanism to operate.

The particular object of the present invention is to overcome this defect and enable pressure change indicating devices of this character to be brought into practical use. They employ as a float chamber an enlargement of the liquid tube leading from the hermetically closed air or gas containing vessel and gradually restrict the area of the vessel by curving its walls converging inwardly—the curve being calculated so that its relative area at the lowest part to which the float may go to the area at its highest part is such that, for any increment of pressure, an equal movement of the float is obtained. The arrangement is of particular value when applied to the purpose of compensating or correcting a recording gas-meter for variations in pressure. For high-pressure meters of the self-correcting type it is said to be of great utility; and in the following description the invention is described as applied to this purpose.



Marsh and Walter's Self-Correcting High-Pressure Meter Mechanism.

A part sectional elevation is given, showing the vessel and shaped float chamber embodied in, and connected up to, a known form of compensating gear.

The gas or air containing chamber A comprises a closed vessel (preferably of glass or other non-porous material, or a metal chamber lined with non-porous material) from which a tube B is lead to a float chamber C; so that the mercury has free communication between A and C. The latter chamber may be circular in cross section, and is then formed with all its surrounding wall surface gradually curved—the curve converging inwardly so as to cause a gradual diminution of the area of the chamber from the upper part downwardly. The curvature is calculated so that the relative area of the chamber at the lowest part to which the float may go (marked E) to the area at the highest part (marked F) is such that for any increment of pressure of the gas an equal movement of the float is obtained, notwithstanding the increasing resistance of the contained air or gas in A.

The float is directly connected to mechanism which is the subject of patent No. 12,668 of 1910. The chamber C is secured to a base G, and the pipe B is separate from the chamber and connected by a union H. The float J is connected directly to the vertically slidable countershaft K of the 1910 patent mechanism, which countershaft is parallel to the meter spindle and carries a gear-wheel for transmitting motion from the spindle to a train of the registering mechanism. L is the spindle to which the meter spindle is connected, and M is the toothed compensating wheel of the patent mechanism. But whereas in the prior patent the movements of the device sensitive to pressure changes were transmitted to the countershaft K through a lever whose fulcrum was between the device and the countershaft, the motion of the shaft was therefore opposite to that of the device now illustrated, in which the shaft and the float J work together, so that the arrangement of the plane space N in the wheel M must be the reverse of that in the earlier patent.

Destructive Distillation of Coal.

WELLINGTON, S. N., of Mincing Lane, E.C.

No. 20,457; Oct. 2, 1914.

This invention has for its object to provide a furnace-setting in which vertical retorts are used whereby the heating of the retorts is effected with a view to the uniform application of heat, and to the precise adjustment of temperature according to the temperature conditions of distillation required.

A vertical section of the setting is given on p. 326, taken transversely through the retorts; also a vertical section taken through the flues between the retorts, and a vertical section of the setting taken along the major axis of the cross-section of a retort.

The retorts are of oblong section, gradually flaring outwardly towards the bottom. They are narrow, so that the heat applied on the broad faces of the retort may quickly penetrate the charge within. Each series of retorts is mounted between transverse walls, and between adjacent retorts and between the end retorts and the enclosing wall of the setting are a number of horizontal partitions, which serve to form separated heating chambers extending across the lateral faces of the retorts. Each of these heating chambers is supplied with preheated gas from a gas pipe or conduit C, which extends to the face of the outer wall of the setting, where cocks are provided by which the supply of gas may be opened or closed. The heating chambers are adapted to operate in pairs; and the heating chambers of each pair on each side of the retorts communicate at the end opposite to that at which

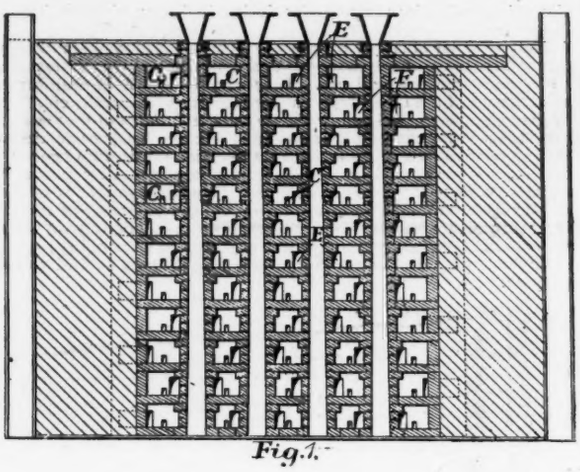


Fig. 1.

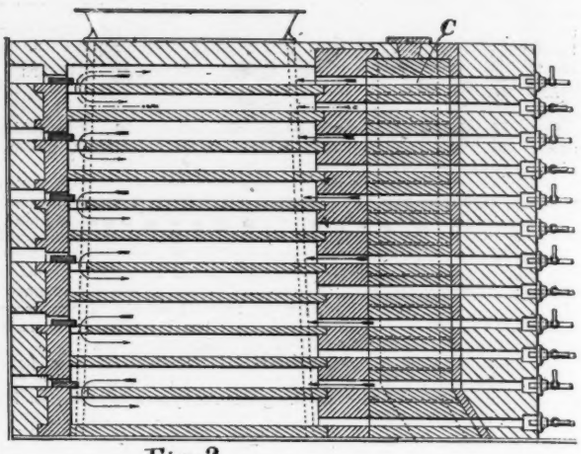


Fig. 2.

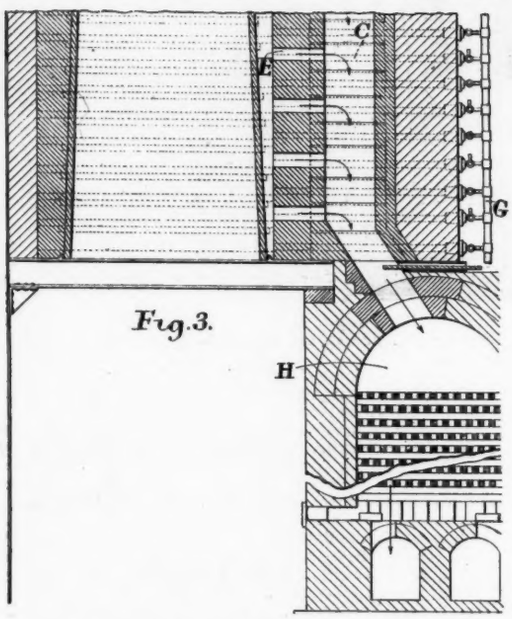


Fig. 3.

Wellington's Vertical Retort Furnace-Setting.

the gas supply is admitted. The port through which communication is made can be partially closed or varied in area by a damper to which access is possible through an aperture provided for the purpose, normally closed by a tile.

At one side of the setting a series of vertical flues are provided; alternate flues being used alternatively for the supply of air to the heating chambers, or for the passage of waste gas therefrom. The flues are arranged in parallel with the retorts, and communication is made between the flues and the heating chambers on each side of the retorts by means of ports E F (in the separating wall of the setting), provided in sets of two in the same plane at such an angle that communication is made between a vertical flue and the heating chambers on each side of the corresponding retort. These communicating ports are disposed in alternate series, so that in one plane—that is, in the plane of the uppermost heating chamber of each set on each side of a retort—the ports E communicate with one vertical flue; while the second and communicating heating chamber communicates with the adjacent flue by the ports F, and so on. Thus the second heating chamber of each set on each side of the retort receives air through the first flue, and discharges the waste gas into the second flue; or the order may be reversed according to the conditions of working. Accordingly, when air is admitted to the first heating chamber of each set gas will be also admitted; while the gas will be cut off from admission to the second heating chamber of each set until the order of working is reversed.

Gas is supplied from a service pipe G extending the length of the setting in a position adjacent to the respective gas-cocks; and each alternate gas-cock may be connected to a common operating rod or chain, or be otherwise connected so that the cocks of each alternate series may be separately operable for reverse working.

The gas-conduits C are provided in the partition walls I serving to form the several vertical flues, as by such an arrangement the gas supply is preheated before it reaches the heating chambers by the absorption of heat from the waste gases passing down the flues.

The regenerator H (formed below and to the side of the retort setting) is divided by walls, which may be extensions of the partition walls, into compartments corresponding in number with the vertical flues—each compartment being filled with a mass of material capable of absorbing heat from the waste gases. Dampers are provided to control the communication between the regenerator compartments and the vertical flues. Below the regenerator are two parallel flues opening at one end to the atmosphere or to a source of air supply and connected at the other end to the chimney or other waste-gas exhaust. Passages are also provided to effect communication between the flues and the compartments of the regenerator. At each end of each flue is a valve or damper, by which the operation of one of the flues as an air supply and the other as a waste-gas outlet is controlled and reversed—that is to say, one set of valves or dampers being closed and the other set open, one flue acts as the air supply and the other flue as the waste-gas outlet, and *vice versâ*, with the result that a reversal of flow of the air and gas in the regenerator and heating chambers takes place. The operation of the valves or dampers may be effected periodically and automatically by such means as electrical time controlling gear, which may also be employed to control the gas-supply cocks.

Carburetting Water Gas.

PORGES, P., and STRACHE, H., of Vienna.

No. 1329; Jan. 27, 1915. Convention date, April 27, 1914.

As is well known, the patentees point out, water gas has been carburetted hitherto by decomposing oil vapours by high temperatures into gaseous hydrocarbons, which were mixed in their nascent state with the water gas. The continually rising prices of the carburetting oils—due not only to their extensive use for the generation of water gas, but also to their being used at present to a large extent for working Diesel motors and other heating purposes—has rendered the use of carburetted water gas unprofitable, because at the present time its price is greater than that of coal gas. In the same way as the prices of the carburetting oils, the price of benzene has also risen continually, because a very large amount of benzene is consumed owing to its extensive use for driving motors—more particularly for automobile purposes. Various processes have already been proposed for producing hydrocarbons of the benzene type, by the destructive distillation of mineral oils, whereby the higher hydrocarbons of the heavier oils are split-up into lower hydrocarbons by heat, with or without the use of a catalyzer, and in some cases with simultaneous use of steam.

The carburetting of water gas according to the present invention consists in splitting up the carburetting oil by destructive distillation in such a manner as to produce hydrocarbons of the benzene type, "with the simultaneous production of considerable quantities of heavy oil gas of great heating power." For this purpose a mixture of oil and water vapours is passed over heated iron oxide or over cast iron that was previously superficially oxidized, whereby the oil vapours are decomposed into oil gas, benzene, and heavy hydrocarbons. From this heavy oil gas the benzenes are separated by condensation in the usual manner, and the oil gas is added to the water gas for carburetting it.

The catalyst (iron oxide or oxidized cast iron) employed for the decomposition of the mixture of oil and water vapours may be brought into the regenerators under hot carburation. The regeneration of the catalyst, which is reduced in the destructive distillation and is covered with a layer of coke or tar, is obtained in the regenerator itself during the blowing period by the addition of tertiary flow of air. The destructive distillation then takes place (in the manner referred to) in the regenerator during the gas period, whereby the oil gas that is formed mixes with the water gas or the like.

The residue left by the destructive distillation, and which contains tar as well as the substances that could not be decomposed by destructive distillation, may be used in the ordinary way like other carburetting oil for carburetting purposes, or the residue is utilized for firing the apparatus in which the destructive distillation is effected.

The yield in benzene is said to cover almost the entire cost of the carburetting oil; "so that the carburetting of water gas can be effected without cost by means of the oil gas produced in the destructive distillation."

APPLICATIONS FOR LETTERS PATENT.

15,040.—GALLIMORE, A. V., "Locks for taps." Oct. 25.

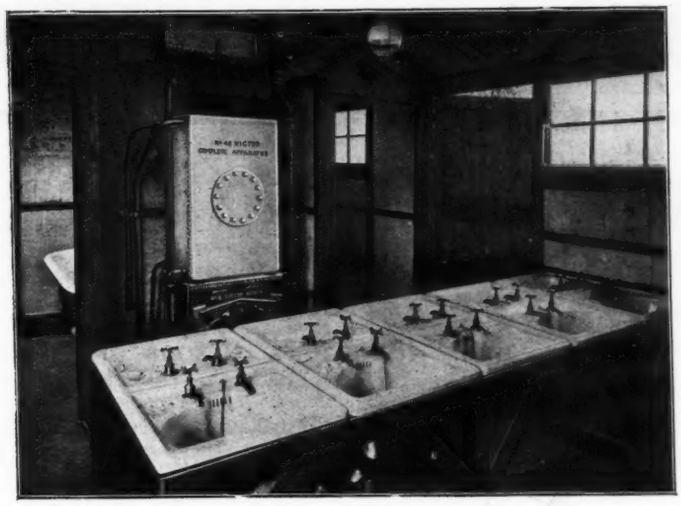
15,129.—CONNOLLY, P., and LOGAN, J., "Globes for inverted burners." Oct. 26.

15,322.—IONIDES, A. C., "Furnaces." Oct. 30.

Mr. W. R. Twigg, the Technical Manager to the Davis Gas-Stove Company, Limited, of Luton, has recently been elected a Fellow of the Chemical Society.

VICTOR GAS BOILERS

FOR MUNITION WORKERS.



In connection with the Y.M.C.A. Housing Scheme for War Munition Workers in various parts of the Metropolis, VICTOR GAS BOILERS have completed the bill by providing hot water for baths and lavatories.

This illustrates the interior of Wash-house at the Enfield Branch, where four baths and ten lavatory basins are provided for residents' and visitors' use.

THOMAS POTTERTON, Heating Engineer, BALHAM, LONDON.

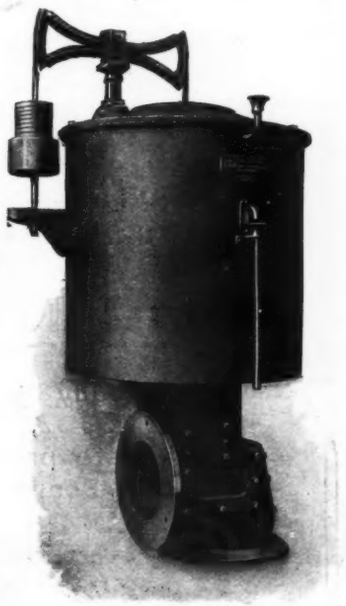
BRADDOCK'S RETORT-HOUSE GOVERNORS

HAVE PROVED TO BE

SECOND TO NONE.

Many repeat orders have been received.

Braddock's New Patent Retort-House Governor is a further improvement and is especially desirable for use with Vertical Retorts.



No. 310.
Braddock's New Patent Enclosed Retort-House Governor. Latest Type.

Further Particulars upon Application.

J. & J. BRADDOCK (BRANCH OF METERS LIMITED), Globe Meter Works, **OLDHAM,**

Telegrams: "BRADDOCK, OLDHAM." National Telephone No. 815.

AND 45 & 47, WESTMINSTER BRIDGE ROAD, LONDON, S.E.

Telegrams: "METRIQUE, LAMB LONDON." Telephone No. 2412 HOP.

TAR DE-HYDRATION.

TOLUOL & PHENOL RECOVERY.

DURING THE WAR

Every additional Tar-Dehydrating Plant is of inestimable value to the Country.

To-day there are many thousands of tons of Tar stored in the Tar Wells.

This Tar contains large quantities of BENZOLE, TOLUOL, and PHENOL, all of which are URGENTLY REQUIRED at the present time.

ALL ENQUIRIES are dealt with in a full and complete manner.

AFTER THE WAR

The market will be greater than ever before for PREPARED TAR and for the DISTILLATES obtained in the De-Hydration Process.

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PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

Lighting of London during Fog.

Lord SYDENHAM asked whether organized arrangements had been made to increase the illumination of the London thoroughfares in case of fogs. He pointed out that the distance between street lights was now two or three times, and in some cases four times, as great as it used to be; while the lamps that were lighted gave only about a quarter of their usual light. With comparatively mild fogs, the streets, under these conditions, would be dangerous; and though it would be impossible to put up temporary lighting for all the streets of London, he thought it would be feasible to have extemporized arrangements to give light to the principal arteries upon which the traffic depended.

Earl CURZON, in reply, stated that, under the new lighting regulations, the provision in the earlier order that, while thick fog prevailed normal lighting of the streets might be resumed, was omitted; but the effect of it was retained by the paragraph which empowered the Commissioner of Police to give any necessary instructions for this purpose. The following were the principal measures adopted for dealing with the problem: The lighting of side streets was being increased by bringing more lamps into general use, so far as this could be done consistently with the general scheme to reduce lighting in the London area; and in some parts of London the number of lamps in use every night would now approximate to three-quarters of the normal. The fact that the lamps were shaded, of course, reduced their normal illuminating effect. A number of lamps which were not in use on clear nights would be lit in case of fog, where the system of lighting and other conditions rendered this practicable.

HOUSE OF COMMONS.

Finance Bill.

Clause 35 of this Bill, relating to trades and businesses to which the excess profits duty applies, was considered in Committee by the House last Wednesday, when Mr. LOUGH moved to exempt municipal authorities from the tax.

Mr. M'KENNA, in the course of his reply, said that Parliament had already decided that the profits of municipal undertakings should be subject to income-tax. Municipal undertakings were in many cases directly competing with other concerns, in which private individuals had invested their money, and from which they might reasonably look for a fair return. He did not, therefore, feel justified in asking Parliament to come to a different decision.

Coal Mining Industry and Enlistment.

In the House last Thursday, Mr. MILLAR asked the Under-Secretary of State for War whether the names of men of military age engaged in the coal mining industry have been starred as engaged in work essential to the successful prosecution of the war?

Mr. TENNANT: This matter is engaging the attention of the War Office. In many cases the coal miners have been starred; but all essential and starred men who may be enlisted will, after enlistment, be returned at once to their civil employment pending inquiry.

LEGAL INTELLIGENCE.

THE RATING OF WATER-WORKS.

Chertsey Union v. Metropolitan Water Board.

In the House of Lords, before Earl Loreburn, Lord Atkinson, Lord Parker, and Lord Shaw, judgment was reserved on Monday of last week in an appeal by the Metropolitan Water Board from a decision of the Court of Appeal dated March 8, which affirmed the judgment of of the King's Bench Division on a special case stated by the Court of Quarter Sessions for the County of Surrey.*

The respondents to the appeal were the Assessment Committee of the Chertsey Union; and the question between the parties was as to the rating of an intake from the River Thames, canal, pumping-station, and premises situated in the parish of Walton-on-Thames, and owned and occupied by the appellants. The rate in question was made in May, 1912; and the premises were assessed at a gross estimated rental of £15,810, and at a rateable value of £10,550. The appeal by the Water Board to the Surrey Quarter Sessions resulted in getting the assessment reduced to £11,677 and £7785 respectively, subject to the High Court affirming the assessment on the special case stated. The Water Board had, under various Acts of Parliament, acquired a right to take water from the River Thames upon payment to the Conservators of certain sums of money. In pursuance of this right, they received at their pumping-station and premises at Walton the flow of water from the Thames over a piece of land on the river bank in their occupation called an "intake." It was not disputed that the intake, works, pipes, pumping-station, &c., were liable to be rated to the relief of the poor; but the Water Board claimed that the intake ought not to be rated beyond its structural value and its value as land. The main question was whether the intake was liable in an additional sum as having an enhanced value by reason of its fitness for the use made of it in taking water from the river. Another point raised was that, being a statutory body, the Water Board were able to borrow money at 3 or 3½ per cent. per annum, and therefore the Quarter Sessions wrongly considered themselves bound in fixing the assessment to take the ordinary rate—namely, 4 per cent. on the purchase value of the land, and 5 per cent. on the value of the works—without considering the special circumstances of the present case.

The Divisional Court held that the intake had an enhanced value; and, further, that, although the Water Board could borrow at less than 4 per cent., there was no reason to depart from the usual practice adopted by Assessment Committees in assessing hereditaments, of taking 4 per cent. on the purchase price of the land and 5 per cent. upon the cost of the buildings. The Court of Appeal agreed with the Divisional Court that the case must go back to Quarter Sessions to add the additional assessment to the value of the intake, on the ground of its enhanced value by reason of its fitness for user; and also held that the basis of calculating the value of the land and premises was right, and must be affirmed. The Water Board appealed.

Mr. RYDE, K.C., and Mr. JACQUES ABADY [holding the brief of Mr. H. FLETCHER MOULTON, serving with H.M. Forces] appeared for the Water Board; Mr. PAGE, K.C., Mr. W. W. MACKENZIE, K.C., and Mr. LAWRENCE TOOTH [holding the brief of Mr. H. CONACHER, serving with H.M. Forces] represented the Chertsey Union.

At the conclusion of the arguments, which were heard on Oct. 26, 28, 29, and Nov. 1, judgment was, as already stated, reserved.

* See "JOURNAL," Vol. CXXII., p. 189; Vol. CXXVI., p. 513; and Vol. CXXIX., p. 679.

A Claim for Glassware Supplied.

A disputed account between Messrs. Hurst and Co., glass manufacturers, of Farringdon Road, and Messrs. William Sugg and Co., Limited, of Regency Street, S.W., was the subject of an action heard last Friday by Mr. Pollock, one of the High Courts Official Referees. Mr. Macaskie, appearing for the plaintiffs, said that the claim was for £97 17s. 8d., the price of glass fittings delivered to the defendants in June and July, 1914. The defence to the claim was that, by writ of the King's Bench Division, plaintiffs claimed £1514 in respect of goods sold and delivered; and in the result plaintiffs accepted the sum of £1450 in satisfaction. The goods forming the subject of the present claim, the defendants said, were included in the previous claim which had been settled. The plaintiffs replied that the goods making up the present claim were not included in the £1514 claim which had been settled. Mr. Latter (for the defence), in reply to the Official Referee, said his position was that the payment made in settlement of the former action more than covered defendants' indebtedness for everything. If the amount paid more than covered what the plaintiffs could make out was due without the £97, then everything had been paid. The Official Referee said that the claim of £1514 was settled for £1450. A compromise was a compromise, and did not show which way the balance was. Mr. Macaskie said the £97 17s. 8d. was in respect of four orders in the month of June, and the deliveries were made in July. When the plaintiffs went over the books after the settlement, they discovered that there was no entry in their ledger of the four items which went to make up the claim in the action. The omission was owing to the fact that plaintiffs were re-constructing their system of book-keeping at the time. The Official Referee remarked that the case resolved itself into the question whether the items claimed for now were included in the original £1514; and it was for the defendants to make out that it was so included. Mr. Latter said that they certainly thought the compromise related to everything supplied at the particular date. In arriving at the settlement the defendants had taken into account all the invoices delivered. The Official Referee, in the result, found that the defendants had failed to show that the items claimed for were included in the settlement of the previous action. There would therefore be judgment for the plaintiffs with costs.

Sequel to an Accident at a Manchester Gas-Works.

A case under the Workmen's Compensation Act was heard at the Manchester County Court, by Judge Mellor, K.C., on Monday of last week. The applicant was Frank Hall, aged 15, a picker, employed at the Bradford Road Gas-Works of the Manchester Corporation; and it was stated that on the morning of June 9 last, while he was, by his foreman's express instructions, pushing coke down a feeding-hole with a long-handled rake, the latter slipped and caught his legs. He was pulled forward; and his right thigh was so badly injured that he had to remain at a Manchester institution for about ten weeks. In cross-examination, applicant said he knew it was the rule of the works that boys should not go near the crusher where the accident happened; but he had to obey the orders of his foreman, when he told him to push the coke down the crusher. Frederick Owen, the foreman from whom the applicant said he had received instructions, denied that he gave any such order. There was a rule, he said, that boys were not to go near the crusher; and he had himself on four or five occasions warned Hall away from it. At the Infirmary, Hall admitted that it was through his own fault that he had been hurt. Witness would get into trouble both with the Corporation and with the Gas-Workers' Union if he set the lads on to feed the crushers. Additional evidence was given that boys were not allowed near the crushers, and that on the morning of the accident Hall had been called from this particular crusher by another workman. The Judge decided in favour of the respondents, with costs.

United Gas-Works Development Company.

On Friday, Mr. Hilyard applied to Mr. Justice Sargant, on behalf of debenture holders, for the appointment of a Receiver in the case of the United Gas-Works Development Company, Limited. He said the the Company had passed a resolution for winding-up [*ante*, p. 282], which made the debentures at once payable; and there was also a case of jeopardy. He did not ask for a Manager, as the Company were not now carrying on any business. Mr. Johnson for the Company, and Mr. Owen Thompson for the Trustees of the debenture deed, did not oppose the motion. All parties were willing that the motion should be treated as the trial of the action, and a final order now made. His Lordship made an order for the appointment of a Receiver, with liberty to him to act at once.

MISCELLANEOUS NEWS.

EVIDENCE ON FACTORY LIGHTING.

There is now given the fifth, and final, instalment of extracts of more particular interest to "JOURNAL" readers, from the evidence given by various witnesses examined by the Home Office Departmental Committee on Lighting in Factories and Workshops. Previous notes of the inquiry will be found on pp. 98, 149, 209, 273. The principal witnesses dealt with to-day—from the gas engineering point of view—are Messrs. A. J. Whyte and J. Angus, of the James Keith and Blackman Company.

Mr. *Percy J. Waldram*, F.S.I., a member of the School Lighting Committee of the Illuminating Engineering Society, said he thought a mixture of artificial and natural light was deleterious. He believed the majority of doctors and physicians were of this opinion. During the last five years, he had noticed a distinct rise in the amount of artificial illumination which people required, and which they would stand. Of course, some years ago the good lights of the present day were not available. It was more or less a question for a doctor to decide whether it was possible for a person to carry on any trade continuously under artificial light only without his eyes suffering. Personally, it would seem to him to be a very doubtful matter indeed. It was the doctor who would not give them the information needed. They wanted the doctors to say how many hours people could work in artificial light.

Mr. *W. M'Dougall* expressed the opinion that it was extremely difficult to carry through any laboratory experiment from which, if a definite result was secured, one could safely infer working conditions. Any experiment on which reliance was to be placed ought to be under ordinary workshop conditions. Asked, on the subject of glare, if there were any means he could suggest to the Committee for discovery whether exposure to strong light for some time during the progress of work was necessarily harmful, witness replied that he thought this was a problem which one could investigate in a general way under laboratory conditions; but it might be a very prolonged and difficult experiment. One would almost be bound to drive the experiment to the point at which some slight injury might be done; and this there was naturally unwillingness to do. Here, again, he could only suggest the alternative of collective workshop experiments.

The CHAIRMAN: We have had a case where it is possible, I believe, to have some experiments carried out, if we can devise them. Women are employed in an electric lamp factory testing the lamps; and they do this all day long by turning the current on to a series of lamps, glowing the lamps perhaps not to the maximum brightness, but very brightly, and examining each lamp. Some of these women have been engaged in the work for several years; and they say their eyesight is still as good as ever. Is it possible to verify this in any way?

Witness: I do not see how you can. I am not at all surprised to hear it. I myself should not in the least expect any injury to the eyesight. I should expect any injury there might be to be seated deeper—namely, in the brain. Probably a general kind of injury might be done without any possible effect on the eyesight. That is to say, I should expect that any condition of strain which is continuing day after day and week after week would tend on the whole to run down the worker, and perhaps to produce a neurasthenic condition, which is one of the general symptoms, and one not easily measurable in definite terms, especially at the lighter stages. I should expect the injury to cause general diminution of efficiency, rather than to be local.

I suppose what you say as to the effect of glare causing no actual injury, but merely a lowering of general efficiency, applies also to the strain which one would get, not from glare, but from insufficient lighting. There, again, I suppose, the results would be general rather than specific?—I think so.

Mr. GASTER: In the United States, the illumination in a large number of factories has been improved; and 30 per cent. show better quality and more output. When they made these experiments of increased illumination, they found an increased output and better quality. This increase continued for a certain period; and then there was a further increase. Then there comes a point where there is no increase, and, in fact, there is a diminution. What would you consider the right amount? Is it the amount where the increased output reaches its highest point, or is this not satisfactory? If you are going to prescribe the minimum amount which is permissible for the workers, at what point do you think you should stop?

Witness: If I understand your description of the experiment, I should have very great confidence in inferring that the best amount of illumination was that corresponding to the top of the curve. I do not know whether I am going beyond my scope if I suggest that rather than prescribe a minimum, the desirable procedure is to bring out the facts, and say: "Here is your maximum efficiency, if you do that." This ought to make prescribing of a minimum unnecessary.

Dr. Young has made experiments as regards fatigue; and he tried the intrinsic brilliance of different sources—incandescent gas and the arc lamp. If you get the operator to look at the incandescent light, it takes a few seconds before he is capable of seeing his work. He found the time it takes is ten times greater in the arc than it is in the ordinary incandescent; and he says this has a lot to do with the amount of comfort of the work?—I should think that is one of the factors of glare.

Would that be a useful way to determine it?—No; I do not think you can rely on the after-image, because, after all, even with an experienced observer, the after-image is very apt to disappear, and then suddenly pop up again through various slight causes which you cannot account for.

Dr. *H. Kenwood*, Medical Officer of Health for the County of Bedford and the Borough of Stoke Newington, said that in his experience artificial lighting in factories was often defective. This was much in evidence at the present time. The worst conditions were to be found in small workrooms, home premises, underground bakehouses, and places of that kind. He would say that no room ought to be used as a workroom in which there was not some daylight; and he would go so far as to urge that no room should be so used in which there was not enough daylight on suitable occasions to enable the work to be carried on. He based his objection to the exclusive use of artificial light on psychological grounds, as well as on the matter of eyesight. If the artificial light was really good, the eyesight should not as a rule suffer materially. Then it was more the physical health that suffered. No one should be allowed to work continuously, by day and night, by artificial light alone, under any conditions.

Dr. *F. R. Cross*, a member of the Council of the Royal College of Surgeons, President of the Ophthalmological Society, and Vice-President of the Ophthalmic Section of the Royal College of Medicine, stated that he had sent to members of the various ophthalmic societies a letter asking for facts "with regard to the occurrence of slight, as well as more serious, ailments of the eyes that may be due to insufficient lighting of factories and workshops." The replies received did not indicate that definite eye troubles were commonly caused by defective lighting of workshops. Out of about 300 replies that he received, nine-tenths were negative so far as regarded any information his correspondents had of damage done to the eye by imperfect lighting conditions in factories and workshops. It was a very unsatisfactory condition of things where all work had been done by artificial light. He did not think the human eye was intended to work for many hours by any form of artificial light that could be conceived. Where local lighting was required, it should be sufficient, and not excessive. It should be specially adapted for particular conditions, to illuminate the work or machinery without irritation to the eyes. There should be an avoidance of glare, flickering shadows, and of separate side-lights falling on the retinæ and pupils of the workmen. The rays emitted should be luminous, with, as far as practicable, avoidance of heat and of ultra-violet rays.

The CHAIRMAN: You say that defective lighting is unsatisfactory for work, causes eye and brain fatigue, headache, and giddiness. We have had it more or less in evidence here that probably defective lighting would show itself in this kind of way, rather than in obvious damage to the eye. Would you agree to that?

Witness: Yes, I think so. It seems to me that the brain would be dissatisfied with the illumination, rather than that any tissue damage would be done to the eye.

One witness has raised the question whether mixed lighting—that is to say, partly artificial and partly daylight—was very seriously disadvantageous or not?—I should think, unless it is very well done, it gives unsatisfactory sight conditions. Probably, for a satisfactory combined lighting, you ought to have an excessive amount of artificial illumination.

Replying to further questions, witness said that for general purposes of purely artificial illumination, although a good "direct" lighting may seem easier of application over certain limited areas of working, he considered "indirect" lighting by reflection a more scientific method under most conditions. With regard to the question of glare, he did not think there was any evidence of this being really deleterious; but it must obviously be unsatisfactory to have half-a-dozen lights throwing different colours on the retina. He agreed that really the only definite injury was from excessive lighting; but if this excessive lighting did do damage, there must be conditions of less degree that were likely to do a certain amount of damage not so apparent.

Mr. *A. J. Whyte* and Mr. *J. Angus*, representing the James Keith and Blackman Company, Limited, then gave evidence; pointing out, in the first place, that the firm made it a rule to keep up the standard of lighting as high as possible, chiefly on account of the fact that they could afford to give an abundance of light, because they could provide it so very cheaply. Further, it had to be borne in mind that maintenance of lamps and fittings was not always attended to; and an allowance had therefore to be made for deterioration of light through this cause. They stated, however, that the light should not be allowed to deteriorate by more than 15 per cent. at any time; and in any contracts of which they undertook the maintenance, provision was made accordingly. To show how the methods adopted by the firm had worked out, a set of tables was submitted giving comparative information and tests regarding several factories. The tables indicated differentiation between general lighting and bench or individual lighting. It was explained that it had been the practice of the firm up to now, in undertaking lighting installations, to take into account the following factors: (1) Where plans had been submitted, they had been careful to get as many particulars as possible of the requirements of the trade, class of work carried out, position of benches, fixtures, machines, &c., and provide for these, in accordance with their experience, lights either on the general or on the individual principle. (2) Where no data had been available, as in the case of dealing with new factories, and they had been asked to provide a lighting scheme, it had only been possible in these cases to allow for a general illumination, which they had calculated for and provided, having regard to the superficial area of the building and the class of trade. For instance, they knew from experience that an allowance of from 1 to 1½ foot-candles per superficial foot would give an excellent result on a working plane approximately 3 feet above the floor. It was obvious, of course, that this calculation was only possible when the total candle power of the lights, together with their height from the floor level, was taken into consideration. Their experience, however, had led them to know at what approximate height certain candle-power fittings ought to be fixed, having regard to the conditions of work in the factory. They had given more, and sometimes less, than this standard on many occasions, according to the conditions of the trade and requirements of customers, and on occasion of competition. This was not stated as a definite standard for calculating the illumination required for any given factory or trade, as it was a rough-and-ready method, which, however, worked out very well in practice, if used with common sense, and with previous experience to go upon. (3) In dealing with existing factories, the question had been very much easier, as everything was open to them, and inspection of the factory being made enabled them to provide the required light for the particular work to be carried out, whether it was individual or general; and this system was one that had never failed, provided subsequent maintenance was reasonably attended to. It was generally considered that a result of from 2 to 3 foot-candles would be

looked upon as adequate lighting in most trades. Regard was had, of course, to the provision of the deep or flat shades, in accordance with the work done in any particular trade. For general lighting, where the fittings could be placed well out of range of vision, they usually employed what was called their flat shade, which, of course, gave a better distribution. For bench lighting, and for individual machine lighting, as well as compositors' desks, they found that much better results were given by the provision of deep shades. At all times, of course, the elimination of deep shadows was kept in mind. This was a simple matter with general lighting; but where the whole of the lighting was individual or bench, then the provision of a few lights of a general character here and there overcame any dense shadows that might result.

The CHAIRMAN: As to the figures that are actually given in the tables. In the first case, shopfitters, machine saws, and setting-out. You say the readings run from 6·5 to 5 foot-candles, on the working plane. Do you know at all how the workmen approved of that?

Mr. *Whyte:* I know personally they were delighted.

I notice in the joiners' workshop the amount is something under 4 foot-candles, which is a good deal less. The first room requires appreciably more light than the next?—That is partly on account of the fact that the illumination was kept up because of the amount of dust. Then, again, the whole endeavour has been to utilize general lighting as much as possible in that factory, and to eliminate the individual lighting, thereby lessening the number of lamps, and simplifying and cheapening maintenance.

Then we come to a tin-box manufactory. I suppose we may take it that for this work 3½ foot-candles is quite good?—It is quite good.

In a motor-car works, the theoretical illumination is rather lower than you told us you generally made. The minimum goes down to as low as 0·6 foot-candle. Is that sufficient in a shop of this kind?—That was adopted in severe competition with electric light. While going over the factory, I noticed half-a-dozen small units of light had been put up since the job was carried out—over saws and places where there was a shadow cast by the man's body. As a result of the installation, we have had another 40,000-candle power contract in a big extension, which indicates approval of the scheme.

Then there is a biscuit factory. Do you know why mixing and ovens require very much more light than packing and cutting? With the cutting-room, you have 1·4 foot-candles as the mean; and in the mixing, 4 foot-candles. Is there something in the work which requires a different illumination?—Yes.

As to the skirt manufacturers. Is the amount of light you usually supply for sewing-machine work something from 7 to 9 foot-candles?—Yes, depending on whether the work is light or dark.

In the boot factory, the first mean reading is 35 foot-candles. This is a very special case?—Yes, the light is flooding down on the needle-point of the sewing machine, but is out of the eye of the operator. The work performed is on black uppers of boots.

Now we come to an engineering works. Here, again, on the fitters' benches and the machines you seem to go for something of the order of 3 to 5 foot candles. Is that your general experience?—In this case the readings are high; but we received instructions to give plenty of light.

In a blouse factory, the illumination varies from about 10 to 19 foot-candles?—Yes; and the people are enthusiastic about the result of this light.

How is it that in another factory it has been sufficient to give 2, 3, 4, and 6 foot-candles?—In this case we merely supplied the lamps and compressors. Often we only supply the plant. But with few exceptions the workers here all expressed complete satisfaction.

May we say that for sewing light-coloured fabric illuminations of the order of 5 or 6 foot-candles are found to be very satisfactory?—Very satisfactory indeed.

Illuminations of the order of 3 or 4 foot-candles?—For light-coloured work, I should say so.

And for dark-coloured fabric?—I express the opinion that it ought to be at least three times as much.

It ought to go up to 10 or 12 foot-candles?—Yes, for dark material.

Replying to further questions, Mr. Whyte said that, as a matter of fact, while the firm had not been in the habit of arranging their light on the plan of foot-candles, this was beginning to be asked for. It was a sign of the times, and a very desirable sign. He had come across any number of factories in the London area where flat-flame burners were employed—chiefly for local lighting.

The CHAIRMAN: For local lighting in engineering shops, because there is nothing very much else to use near the lathes?

Mr. *Whyte:* I know that is fairly common; but we have been able to do away with it largely by using a high-pressure incandescent light properly placed. We also employ for this class of lighting an adjustable lever pendant, which allows of the light being moved to almost any position required by the operator over the working parts of the lathe.

Have you any evidence as to increased output or better work or more satisfactory or less satisfactory results accruing from your work?—Yes, particularly with regard to colour matching, and also the effect it has on temperatures. We had a letter this morning which says: "We consider the system conduces more to the health of the workers. After nearly eighteen months' experience of your high-pressure gas system, we should like to say that we have found it entirely satisfactory for our needs. The light has been continuously steady and brilliant, and is a great improvement on our former arrangements. Though our workrooms and offices are so much better lit than before, we have, at the same time, made a saving in gas consumption of over 50 per cent." I brought the letter to your notice because of the remark, "We consider the system conduces more to the health of the workers."

Witnesses, referring to sewing factories for blouses, &c., stated their opinions that the comfort of a machine operator was largely influenced by the amount of contrast that was rendered in the lighting—that was to say, in their judgment a general illumination of a fairly low intensity was preferable to an illumination which was greater at its maximum point, but which was cut up or interspersed with deep shadows. These shadows, they mentioned, were greatly exaggerated when dark material was being worked upon, since there was no reflection to equalize the distribution. They considered a much higher average of illumination should be maintained when work was being done on dark materials than was necessary with white or light coloured fabrics. What really mattered in this class of lighting was correct position and number of lights, which arrangement would provide for the elimination of shadows. In their opinion, with this class of work, the foot-candles where light work was dealt with should not be less than 3 to 4, and for dark work double or three times this.

Dr. *T. W. Heywood*, Certifying Surgeon for Darwen, expressed the opinion that until five years ago the lighting of the mills was undoubtedly bad. It was, however, an established fact that the rate of deterioration of eyesight was very considerably less than was the case some years ago; and this was in consequence of improved lighting. In his experience, accidents due to bad light had occurred.

Mr. WHETHAM: Do you think that bad lighting affects the nerves, or anything of that kind? For instance, do you think if one tries to read constantly by an insufficient light, it would definitely affect one's nervous system?

Witness: It probably would produce trouble with the nerves.

You have no actual evidence of specific cases of the workers?—None whatever.

The CHAIRMAN: Is incandescent gas more general in your neighbourhood than electric light?

Witness: Yes, they get a much better light. Another thing, incandescent gas is warmer; and that has something to do with these people.

Mr. *W. E. Potts*, appearing on behalf of the Royal Institute of British Architects, gave evidence with regard to the building of mills from the point of view of natural lighting.

Mr. *J. B. Gass*, F.R.I.B.A., said it might be taken that millowners generally appreciated the importance of proper lighting. Describing the artificial lighting of a mule room in a mill, he pointed out that gas was found to be the most satisfactory lighting, with the ordinary pressure, and the inverted mantles enclosed in globes. These were nominally 80-candle power, and were placed to illuminate 30 cubic feet and 2·5 square feet of area per candle power. The mantles had not too great an intrinsic brightness; they were kept as much out of the field of vision as possible; the light got well distributed; and they gave illumination with steadiness and economy. They were about six times as efficient as an ordinary gas-flame with the same consumption; and, with the globes, were free from danger, with reasonable care. Allowance was made in the arrangements for the drop in efficiency, which was from 30 to 50 per cent. in 100 hours; and they required changing after 250 hours' use. This supposed that 1-candle power would illuminate 4 to 5 feet. The figure of 2·5 feet was taken to allow for the drop in efficiency. In some mills electric lighting had been adopted throughout, using first the carbon lamp, and later the metallic filament. Ease of use, freedom from fire risk, cleanliness, and non-pollution of the air, gave electric lighting a special advantage; the main objection being the intensity of the luminous source. Incandescent electric lamps had at least twelve times as much intrinsic brightness as incandescent gas-lamps, and they did not give such equal diffusion of the light. There was the usual drop in efficiency with use. High-pressure incandescent gas lighting had the same disadvantages as electricity—too great intensity at the luminous source. Reflected electric lighting for mule spinning had been suggested; but as there was a heavy loss in the value of the actual illumination, it was unlikely to come into use, though it might be made very effective. There was at least 40 per cent. loss to start with. It was a very nice light; but this made it much too expensive. For weaving sheds and other processes where the light required concentration and local illumination was necessary, electricity could be satisfactorily used, as the direct light could be kept out of the field of vision.

The CHAIRMAN: Now we come to the question with regard to the possibility of fixing a standard, and the form of that standard?

Witness: Without making a standard, it might be desirable for the factory inspector, in conjunction with the local authority's engineer or surveyor, to have power to deal with cases in which the lighting, both natural and artificial, was such as to be injurious to the workers, with right of appeal by the owner in case of alterations being required or the building being closed, to a special committee of the local justices, who should be appointed for their special knowledge of, or connection with, the trades of the district.

Sir ARTHUR WHITELEGGE: You would base the matter, then, on the probable injury to the workers in health. You would include the sight in that, no doubt?

Witness: Certainly.

Would you agree to a suggestion made by the Chairman, that, without making a standard, it would be useful evidence in such a case to say the actual illumination in the room under discussion was very much less or very much more than, or equal to, that found in admittedly well-lighted sheds of the kind?—That would be useful evidence.

Mr. PARSONS: Are there any injuries or any complaints of injuries to sight or health which have come to your notice?

Witness: No, they have not been brought to our notice.

Mr. GASTER: On the question of injury, do you take into account a man having to work under conditions where the light was badly placed, causing him to twist his body?

Witness: That would be an injurious condition, and would be one of the things which, if a man would not alter, any right-minded local justice would at once say had to be altered.

Several working tailors next gave evidence of unsatisfactory lighting and other conditions in workrooms, by which their eyes were affected. The light was gas; but it was complained that there was not enough of it. One of the witnesses, however, summed up the situation with the remark: "So long as you have workshops in the East end of London in private houses, the best of light will not help much."

Mr. *John Dewrance*, Chairman of the Parliamentary Committee of the Engineering Employers' Federation, asked what he would say as to some general kind of regulation that in factories under the Home Office the lighting should be adequate, replied that it seemed to him this was the best definition, or "as near as can be reasonably expected under the circumstances," because there must always be exceptions to any rule that was laid down. A large number of employers would be

extremely grateful for any suggestions for improving lighting; but this might not be the case with people who were tenants only, and those who were not able to afford expensive alterations. There was no lighting which was always satisfactory, and which satisfied everybody. For most of his own workshops he had electric light for general illumination; but each particular machine had flat-flame gas-burners for individual lighting. He preferred electricity, but could not use it for individual lighting, because the lamps were apt to be broken. The men were always complaining about the light. Most complaints arose when there was daylight and artificial lighting. They had altered the artificial lighting in one factory, he believed, five times during his recollection, to try to get it as satisfactory as possible. They had incandescent gas. Then they went in for arc electric lighting; and afterwards they had two different systems of incandescent lighting. But the difficulty of lighting satisfactorily was so great that he did not pretend they had really solved it at the present time. It was exceedingly desirable that the lighting in all factories should be as evenly distributed as possible, rather than have big, powerful lights. The only experience he had had of any injury which he attributed to light was in the case of a man who had to watch the pouring of brass. It was extraordinary, but apparently the men who worked in badly-lighted places did not really seem to suffer.

Mr. *Lewis Solomon*, F.R.I.B.A., expressed the opinion that it would be very difficult to get evidence of direct injury from working continually in artificial light. High-pressure gas was cheaper and more effective than the electric light; and a man could work by it better. There was something about high-pressure gas which was not so deleterious as electric light to the sight. The workpeople liked it. He thought that at first there would be enormous difficulties in enforcing a standard.

Mr. *Segar Owen*, F.R.I.B.A., stated that of late years all the shops which he had built had been lighted with the ordinary arc lamp, and special provision had been made for reflecting the light on to the roof, and thus screen the immediate rays of the lamp from the employee's eyes. With the use of the metallic filament lamp, it had become of late more usual to light the shop throughout with pendant lamps fitted with this class of electric bulb. In this case, the opal shades of glass were sometimes reversed; but unless the roof members and boarding were painted of a white reflecting colour, a considerable amount of light was lost to the shop.

Mr. *Henry Hartley*, representing the Surveyors' Institution, stated that, in his opinion, the best form of artificial lighting was electricity, using the metallic filament lamps with prismatic reflectors. Next he placed high-pressure incandescent gas; and after that electric arc lamps. He regarded the first method, adopting metallic filament lamps of (say) 50 to 100 candle power as the best, for various reasons. There was a better distribution over the whole area to be lighted, a steadier light, and an absence of shadows, as compared with arc lights. The lights should be kept up close to the ceiling or to the underside of the tie-beams, so as to get a better diffused light. They should be fitted with reflectors of the "extensive" type, which distributed the light over a large area. The power and number of the lamps must be determined by the nature of the walls and ceilings. The distribution of the lights must also be determined by the same conditions. High-pressure incandescent gas lights should be placed as suggested for the metallic filament lamps, and should also be fitted with reflectors. The objection to this system in some cases was the heat that was generated. The unsteadiness of arc lights was a great objection to them. He did not think there would be any difficulty about a regulation to the effect that artificial lighting should be adequate.

Mr. *F. Skull*, of the High Wycombe Chamber of Commerce, gave evidence to the effect that it was scarcely possible to define or establish a standard or standards of adequate illumination suitable for the various operations and processes in the chair trade, neither was it desirable. Legislation requiring adequate lighting would not touch those he represented, because they already had adequate lighting.

Mr. *William Eccles*, another member of the High Wycombe Chamber of Commerce, and manager of a paper mill, said he scarcely saw how a standard could be defined, though he agreed that they must have adequate lighting.

Mr. *T. H. Thorpe*, F.R.I.B.A., appearing on behalf of the Derby Chamber of Commerce, stated that the manufacturers he represented wished him to say that they thought it was practically impossible to define and establish a standard of adequate illumination applicable to them. Some such regulation as was in force in Holland, he admitted, might be made. All manufacturers he had come across agreed that it paid to give good lighting. The general system in Derby was electric light. In a few cases he found that factories used high-pressure gas. It was preferred, he thought. He knew nothing of complaints as to lighting injuring the vision. His own personal opinion was that indirect lighting was better than any other.

The examination of this witness brought to a close the sittings of the Committee for the hearing of evidence.

CHELTENHAM GAS STRIKE ARBITRATION.

Mr. Mackenzie, K.C., an Arbitrator of the Board of Trade, presided at a conference at the Town Hall, Cheltenham, last Tuesday, between representatives of the Gas Workers' Union and the Gas Company, with reference to the recent strike. As reported in our issue of the 26th ult. [p. 214], the contest was ended by a truce, in which both parties agreed to submit to arbitration by the Board of Trade the questions of a war bonus of 3s. 6d. a week all round and of recognition of the Union. The Press was excluded by the Arbitrator from attending the conference, which lasted about three hours.

The men's representatives, interviewed afterwards, stated that the question of recognition of the Union was deferred for the present, and that the Arbitrator would only submit to Sir George Askwith his proposals in regard to the war bonus. The Arbitrator will, in due course, communicate his award.

QUALITY OF DUBLIN GAS.

Discussion at the Kingstown Council.

At this month's meeting of the Kingstown Urban District Council, Mr. J. J. Kennedy called attention to what he described as the bad quality of the light which the township was receiving from the Alliance and Dublin Consumers' Gas Company. It really was, he said, exceptionally bad. In the past, they had had reason to complain of the quality of the gas; but never in his experience had the light been so wretchedly bad as it was at the present time. There had been a new contract entered into at an advanced price, owing to the greater cost of production; and one would imagine that, when the Company were previously met by the Council with an increase—a substantial increase—on the previous payment, the quality of their supply would at least be maintained at that middling description of gas which they had been in the habit of getting. Now, however, the gas was wretchedly bad. Again, there were many cases where lamps were not lighted until it was almost time to turn them out. This was not fair treatment of the ratepayers of Kingstown. In a district not a hundred miles away, not very long ago, every second lamp was out at a time when all should have been lighted. Surely, if the Gas Company had not enough men employees to do their business, they could get women lamplighters. He suggested that the Company should be communicated with on the matter. It would be better to save the ratepayers' money and live in darkness than pay a substantial amount of public money for something which they were not getting.

The CHAIRMAN (Mr. M. F. O'Brien, J.P.) said he quite approved of Mr. Kennedy's action in bringing the matter forward.

Mr. EVANS, J.P., said a great number of the ratepayers had been complaining of the gas—not only in regard to public lighting, but also as to private lighting. He did not know what the technical reason was; but the quality of the gas was getting worse and worse.

The Town Clerk was instructed to communicate with the Company on the subject.

MANSFIELD GAS UNDERTAKING.

Special Auditor's Report.

Following up the matters in connection with the Mansfield gas undertaking to which reference has been made in recent issues of the "JOURNAL," the subjoined statement appeared in last Thursday's edition of the "Nottingham Daily Express."

Remarkable disclosures relative to the working of the Mansfield gas undertaking were revealed at a special meeting of the Town Council held last night at the Town Hall. The members met in private under the chairmanship of the Mayor (Alderman T. H. Maltby), to consider a report of the Gas Committee; and their deliberations in committee occupied a period of over two hours. It was after 10 o'clock when the Press were admitted to the meeting; and the Chairman of the Gas Committee (Mr. T. Smith) then made a statement on the matter.

At the outset, Mr. Smith remarked that the observations he was about to make would be made without bias; but he had a duty to perform to the ratepayers. The annual report of the Gas Committee presented to the Council, he said, was of such an unsatisfactory nature that the Committee had no alternative but to place the matter in the hands of a competent Auditor. They selected Mr. W. Gath, of Nottingham, who was given instructions to pay special attention to certain points, and to go thoroughly into the affairs at the gas-works.

In the printed report, the members would notice some big increases in the expenditure. These, of course, were largely accounted for by the extra cost of gas production—an increase which worked out roughly at £2550. On the income side, they had sold £1400 more of gas and residuals, and yet had realized £1200 less than last year. In spite of the loss allowed for owing to war conditions, the Committee found they had lost £1340 on the past year.

Dealing with the monthly reports and the actual facts of the yearly report, Mr. Smith said statements presented showed that the make of gas per ton of coal carbonized varied from 12,309 to 12,219 cubic feet, or an average of 12,157 cubic feet; but the yearly report showed the average of 10,971 cubic feet of gas made, or 1186 cubic feet less than the monthly report stated. This, on the year's working, misled the Committee to the extent of 21,944,558 cubic feet, or, in other words (taking the price of gas at 2s. 6d. per 1000 cubic feet), £2743.

Mr. Smith went into certain figures regarding bye-products, carbonization, and gas-stove hirings, and in conclusion said he thought the Council would be quite satisfied that the Committee had not been neglecting their duty, but that they had been misled by the reports presented monthly, over which they had no control. The Committee had anticipated a profit about as large as that of the previous year; and if they took the figures which he had given them, they would find they should have made a profit of £2003; whereas there was a loss of £1341.

The report, after a brief discussion, was adopted.

A Record Price for Dye.—A keg of about 1½ cwt. of methylene blue dye, which before the war would have been worth between £12 and £15, realized £310 at a Midland Railway lost property sale conducted at Derby last week. The bidding commenced at 5s.

Percentage Profits at Halifax.—Reporting on the accounts of the Halifax Corporation for the year ended March 31, the Borough Treasurer (Mr. G. H. Fry) states that the profit on the gas-works was £5758, or 0·88 per cent. on the total capital expenditure. The net cost at works for the manufacture of gas was 16·39d. per 1000 cubic feet, compared with 13·82d. the previous year. The electricity works profit was £13,036, equal to 4·29 per cent. on the capital expenditure. The water-works showed a loss of £11,195. Up to the present time, 342 of the Corporation staff have joined His Majesty's forces. The total amount of war expenses for the year was £6243, equal to a rate of 3·38d. in the pound.

SOUTHAMPTON GAS COMPANY.

The Half-Yearly Meeting of the Company was held last Wednesday, when there was adopted the report of the Directors, which stated that, as compared with the corresponding half of 1914, the sale of gas showed an increase of 14,583,000 cubic feet. The revenue from the sale of residuals was also larger, arising from greater quantities being produced for sale, and also an improvement in prices. In order to meet the great increase in the cost of coal and other materials used in the manufacture of gas, as well as the war bonuses paid to the employees and the allowances to dependants of employees serving in His Majesty's forces on sea and land, which represented a very serious addition to the ordinary charges the Company had to meet, the Directors were reluctantly compelled to increase the price of gas by 4d. per 1000 cubic feet to ordinary consumers, and 2d. to prepayment consumers, as from April 1. This increase was very moderate compared with that made by many other gas companies. The amount available for the dividend on the ordinary stock, after payment of debenture interest and other charges, was £13,966, to which was added £5586, the undivided profit from the previous half year, giving a total of £19,552. The Directors recommended that the maximum dividend of 5 per cent. per annum, amounting to £16,193 10s. for the half year, be paid (less income-tax), leaving £3359 to be carried forward.

Mr. J. C. Moberley, M.A., the Deputy-Chairman, who presided, read some notes prepared by the Chairman (Captain A. J. Corse Scott, J.P.), who was absent through illness. These pointed out that the accounts under review had only received the benefit of the increased price during the poorest quarter of the year. Coal had cost £8300 more; the average increase per ton being 8s. Savings had been effected in other directions; but in order to pay the maximum dividends, it would be necessary to draw upon the undivided balance of £5586 to the extent of £2227. Owing to the continued depreciation of securities, the Directors had considered it advisable to write-down the values of the investments from £54,203 to £46,156. During the summer, every effort had been made to bring the stock of coal up to the normal; and at the present time the stock was the largest ever carried by the Company. The number of employees who had joined the forces was now nearly a hundred; and doubtless under the new recruiting scheme many others would enlist. Protection had, in some measure, been afforded to the Company to retain a certain number of the employees by the issue of badges to those who were indispensable for the manufacture of gas and the directing of the Company's business. The Chairman pointed out that in the matter of coal the Directors had been greatly assisted by the Secretary (Mr. J. R. H. Jacobs), who had taken the greatest trouble in the matter.

M. Howlett and Co. has been registered as a joint-stock company, with a capital of £20,000, in £1 shares. The business carried on by the firm is that of manufacturers of incandescent gas-fittings.

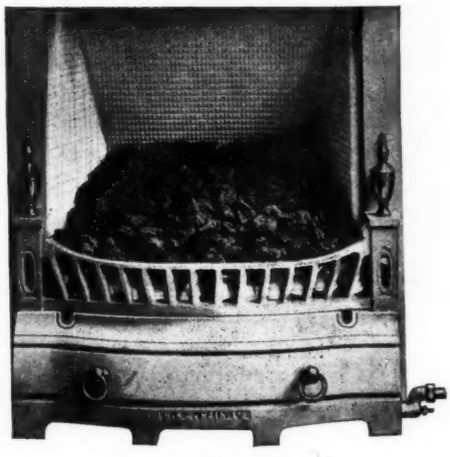
SOUTH AUSTRALIAN GAS COMPANY.

An Inquiry at Adelaide.

A number of sittings have been held, in Parliament House, Adelaide, by a Royal Commission appointed to inquire into the gas and electricity services in the city.

Addressing the Commission on behalf of the South Australian Gas Company, Mr. W. J. Isbister said the profits on the capital actually subscribed to the Company had averaged 14 per cent. This would have been the average return which an original shareholder, if he had lived and held the shares right on from 1861, would have obtained. He would not actually have received it; but this was what the Company had earned on the subscribed value. The money was not all distributed. The pioneers of such an enterprise were entitled to special consideration. The venture was not at all rushed at the start. Not all the share capital was taken up; and when the Company wanted to borrow money, they had to pay 8 per cent. for it; so that the figures which seemed so attractive were not quite the same proposition viewed in perspective. The net profits, not dividends, on the capital employed for the period 1910-13 were 11·36 per cent. This represented what might be called the high-water mark of the enterprise, when the Company had the advantage of all the reserve funds not bearing interest, and a great increase of business and prosperity which occurred in those years. The dividends all through on the capital employed amounted to 7·35 per cent. The dividend to the investor buying on the market was a little under 6 per cent. This was really the rate of return to practically all the present shareholders, apart from about 10 per cent., who had held shares for more than twenty years, and was the result of careful and prudent management, not distributing profits lavishly, and relying on the protection which it was assumed they had with regard to their rights. These figures were incontestable. Without making adequate provision for depreciation, but distributing all the profits, the Company would, even after a period of unexampled prosperity, have gone hopelessly smash. They could not possibly declare what their profit was until they had charged the revenue for the year with something for depreciation, among other things. The depreciation provision was not a part of the visible profits at all, and could not therefore have been added to the reserve fund. It was one of the working expenses, in the same way as wages. Some point had been made as to the amount carried to depreciation in one particular year; but what should be ascertained was the amount carried in the aggregate to this account. If depreciation had not been properly provided for in the past, a large sum had to be set aside for it when the want of adequate provision was realized. On the other hand, if proper provision had been made in the past, an average amount—it might be small—would be sufficient. If the sum set apart for depreciation during the last seven years was taken, the average worked out at £13,159; and the average percentage which this bore to the capital

THE MAIN GAS FIRES.



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employed was 2·69. If the facts were looked at fairly, as well as the figures, he did not think it could be said the shareholders had had an excessive return. The prices charged in Adelaide for gas compared very favourably with the rates in the other cities of Australia. The Company had from the earliest stage seen that, in order to induce business, they must reduce their charges at times. In Sydney, Melbourne, Brisbane, and Auckland, coal cost much less than in Adelaide. The longer hours of sunshine in Adelaide, compared with Melbourne and Sydney, and the need to cross a wide belt of park lands, affected the position from the standpoint of a lighting proposition. The Company had been subjected to a close and critical scrutiny—he did not say an unfriendly one—and it had tended to show that the business had been honestly and prudently managed. The return to the shareholders, who were in many instances persons of moderate means, had not been excessive, taking everything into account. The self-denial of the shareholders in not distributing all their profits had enabled the concern to be built-up with a stability which it would not otherwise have had, and allowed the Company to cope better with the progress made by Adelaide during the last ten years, thus giving the public a substantial share of the benefits which had accrued to the Company by reason of this progress.

PUBLIC LIGHTING OF MANCHESTER.

Fatalities through Restricted Conditions.

Animadversions respecting the public lighting of the main streets of Manchester were freely indulged in at the City Coroner's Court last week, when inquests were held respecting the deaths of persons knocked down by vehicles.

A fatality to a man named Gibson was inquired into on Monday. He had been fatally injured the previous Friday night by a motor-car in Albion Street, Gaythorn. The driver of the car told the Coroner that just at the particular spot where the fatality occurred two high-pressure lamps were fixed. Neither of these was lighted. Along the road, one lamp was lighted and the next was out, thus giving a light patch and then a dark patch. A passenger in the car said the public lighting of Manchester was exceptionally bad at the present time. Various protests had been made to the Gas Department about it. They had expressed the hope of being able to make things more comfortable; but some higher authority seemed to over-rule their proposed concessions. At the point where the fatality occurred, the lighting was very bad.

The fourth fatal accident in five days in which the lighting restrictions have been called into question was inquired into on Friday; a boy named Leonard Jones having been knocked down by a tramcar in the Bradford district, and receiving injuries from which he died. The driver of the car and other witnesses stated that the place where the accident occurred was particularly dark. The Coroner, addressing the Jury, said it appeared from the evidence that this accident was to some extent due to the darkness of the street. Something ought to be done; for it seemed to him that there would be more accidents of this kind if the bad lighting of the streets continued. It was necessary to take precautions under the Defence of the Realm Act; but he thought these could be carried to a somewhat ridiculous extent. Between 6 and 7 in the evening was the worst time for the public. Thousands of people were going home from work; and as much light was wanted in the streets as it was possible to get. He thought something might be done to provide better lighting between 4 and 8 or 9 p.m. The Jury recommended that representations be made to the civic authorities, to see whether this recommendation could be carried out.

WAR BONUS QUESTION AT OLDHAM.

Report of the Special Arbitration Committee.

A report on the conference between Sir George Askwith (Chief Industrial Commissioner) and representatives of the Oldham Corporation, the Gas-Workers' Union, and the Municipal Employers' Association, in regard to the question of granting a war bonus to employees in the Gas and Water Departments [*ante*, p. 94], was discussed by the Special Committee who have had the matter in hand, at a private meeting at the Oldham Town Hall last Thursday, when it was decided to recommend the Council to agree to the terms decided upon at the conference.

The claim of the men has been before the Council on various occasions during the last few months; the original demand of the men being for a war bonus of 5s. The Committee had recommended an advance of 2s. a week to all employees above 21 years of age receiving less than 28s. per week, and 1s. to those receiving 29s.—confining the bonus to those whose wages with the advance would not exceed 30s. per week. The employees' unions demanded an advance of 3s. a week all round, without any limitation to 30s. per week or any other figure. The Council refused this, and a strike had been threatened; but Sir George Askwith intervened, and requested a conference with the parties to the dispute.

The following are the terms of settlement:—

The Corporation agree to give their employees of 21 years of age and over a war bonus on the following scale: Men receiving 31s. per week and under, 2s. per week. Men receiving 31s. to 31s. 6d., to receive 33s. per week. Men receiving above 31s. 6d., and up to and including 45s. per week, to receive a war bonus of 1s. 6d. per week.

The above bonus is not to include men who have received advances since the beginning of the war, and is to date from Aug. 11 last. The bonus is not to be taken off after the end of the war without three months' notice being given, or a conference being held.

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COAL TAR AND ITS PRODUCTS.

Continuing the correspondence on this subject recently reproduced in our pages [see *ante*, pp. 150, 211, 278] from the "Iron and Coal Trades Review," the writer, "Distillation," on Friday last, made the following remarks.

The "little explanation" of Messrs. Hird, Chambers, and Hammond does not in any way alter my opinion that the article was misleading, and the statements exaggerated. In fact, their reply indicates that the results they have put forward are mostly assumed or calculated, and not the result of practical operations.

In the article they said the results were realized from average tar; but in their reply we are given to understand that the tars were known to be of high quality, and to contain high percentages of oil. The writer further gathers that the tars are from gas-works, which are generally of different quality from coke-oven tars.

With reference to the production of benzol, it was natural to assume when they spoke of rectification that they referred to finished and not crude products; and certainly the prices given were those of finished products. As to the cost of production, they now state they are prepared to give a firm undertaking that this will not exceed £279 for 60,000 gallons. The writer knows, from several years' practical experience, this cannot possibly be accomplished at the present day.

With regard to carbolic and cresylic acid, here again they reply by offering to send particulars of their patent plant. What the writer asked was: Where had a plant (described by them as a very simple plant) been erected by them and turning out the quantities they assert, and realizing the prices they quote?

No satisfactory explanation is given why 1913 prices are used, instead of present-day prices; and the only conclusion the writer can arrive at is that the former are more favourable for the firm in pushing forward their particular plants. If anything approaching the profits stated could actually be realized, tar-distillation plants would be springing up wherever there were patent bye-product ovens and gas-works. But it is known the large distillers are not realizing fortunes out of tar.

When the writer referred to the price of tar, he had in mind contracts for average tar, and not a special product for which it may be possible 37s. per ton is obtainable. It stands to reason that with pitch —which constitutes from 60 to 70 per cent. of the products of distillation of average tar—realizing 15s. per ton at the works, and huge stocks accumulating in the country, the distillation of tar is not making the fabulous profits the firm would lead one to think.

They ask, "When shipping conditions become normal again what will the present stocks of pitch realize?" Business people, as a rule, do not put money into a plant when the chief product is likely to be put into stock, it may be for years, until they "wait and see" normal conditions reinstated after a world war has devastated countries and upset all economic and financial conditions.

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

The death is announced of Mr. George Shearer, Town Chamberlain of Banff, who, in addition to various other offices, occupied the position of Secretary and Treasurer of the local Gas Company. He was 61 years of age, and was a native of Banff, in which town he had spent nearly all his life.

The abstract of the accounts of the Burgh of Forfar has now been issued in accordance with the provisions of the Town Councils (Scotland) Act, 1900. The figures in relation to the gas supply undertaking show that the outlay on gas manufacture during the year ended May 15 last was £7123—coal, including carriage, costing £5359. Distribution charges amounted to £549; rents, rates, taxes, and insurance, £534; the proportion of general administration charges, £135; and other expenditure, £1006. These amounts total to £9348. Sales of gas, after allowing discounts and adding arrears collected, brought in £7998; residuals, £2950; and other expenses, £680. There was a balance of £2281 to be carried to the net revenue account. From the statistics as to gas manufacture during the last financial year, it appears that 6307·4 tons of coal were carbonized, costing an average price per ton of 16s. 10d. The total make of gas was 62,780,100 cubic feet, of which 6,484,200 feet were unaccounted for, or a loss of 10·33 per cent. This showed the average quantity of gas made per ton of coal was 9954 cubic feet. The average price of gas during last year was 2s. 10d. per 1000 cubic feet. Since 1904-5, the amount of coal carbonized has increased from 3572 tons, and the make of gas from 35,058,700 cubic feet, to the figures already mentioned. The total revenue from the sale of gas and residual products advanced during the same time from £5990 to £10,879.

At the Granton Gas-Works, for Edinburgh and Leith, the blacksmiths have had their wages raised to 9d. per hour. In addition, the men receive ½d. per hour war bonus, and a number of other advantages—embracing three weeks' full pay and three weeks' half pay when sick, ten days holidays on full pay, continuous employment, and the benefit of a pension fund.

The Inverness gas stokers have obtained an increase of pay on a very liberal scale. The leading men are being paid 43s. 9d. per week, or an increase of 4s. 3d. per week; and the general stokers 40s. per week—an increase of 3s. 9d. per week.

The Perth Gas Committee have had an interview with a deputation of the employees of the department who have made an application for an increase of wages. The Committee decided to adhere to a resolution passed by the Council some time ago that no war bonuses or increases in wages be granted during the period of the war. It is understood that the gas workers have indicated their intention of approaching the Minister of Munitions in regard to the matter.

The Kirkcaldy Town Council have received an "ultimatum" from

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the gas-workers. The men are demanding an increase in wages, and threaten to strike in a week's time unless a satisfactory reply is received. The Gas Committee have the matter in hand.

Last Saturday, a visit was paid by the Council of the National Registration of Plumbers to the Glasgow Corporation Gas Department workshops, in Walls Street. A very large party accompanied Mr. J. R. Sutherland (the Corporation Water Engineer), President of the Association. Owing to the absence of Mr. Ralph Halkett (the Commercial Superintendent) through illness, the visitors were received by Mr. James M'Ghee (Workshops Superintendent), who, in according them a welcome, referred to the great development which had taken place during the last few years in the Distribution Department. The party divided into three groups, who were accompanied through the works by Mr. M'Ghee and his assistants. The new card system introduced by Mr. Halkett was first of all explained, and thereafter the various shops were visited. The different types of machinery, the cooking and heating apparatus, and the repairing and testing of gas-meters proved of great interest.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *Nov.* 8.

The tendency of the freight market seems to be a little easier, probably owing to the difficulty of fixing business at the high figures quoted. This may react somewhat on the price of pitch. Values of tar products generally remain the same as last recorded.

Considerable business is reported in sulphate of ammonia—£15 5s. per ton net, in buyers' bags, at makers' works, having been paid for 25 per cent. quality right down to June next; and the whole position is very firm.

Tar Products in the Provinces.

Nov. 8.

The market for tar products remains about the same. There is still very little business doing in pitch. Creosote is offering at reasonable prices. Solvent and heavy naphthas are in good demand.

The average values of gas-works products during the past week were: Gas-works coal tar, 19s. 6d. to 23s. 6d. Pitch, East Coast, 18s. to 19s. per ton; Norfolk, Suffolk, and Humber ports, 18s. to 19s.; West Coast, 17s. to 18s. Manchester; 18s. to 19s. Liverpool; 20s. to 21s. Clyde. Benzol, 90 per cent., North, 10½d. to 11d.; 50-90 per cent., naked, North, 1s. 3d. to 1s. 4d. Toluol, naked, North, 2s. 3d. Coal tar crude naphtha, in bulk, North, 6½d. to 7d. Solvent naphtha, naked, North, 1s. 11d. to 2s. Heavy naphtha, naked, North, 1s. 2d. to 1s. 3d. Creosote, in bulk, North, 2⅝d. to 3d. Heavy oils, in bulk, 3⅝d. to 4d. Carbolic acid, casks included, 60 per cent., East and West Coasts, 3s. 6d. Naphthalene, £18 to £28; salts, 75s. to 80s., bags included. Anthracene, "A" quality, 2d. to 2½d. per unit; "B" quality, nominally ¾d.

Sulphate of Ammonia in the Provinces.

LIVERPOOL, *Nov.* 6.

Throughout the week the market for this material has continued to advance steadily from day to day, and at the close the tendency is still upwards. There have been large requirements for practically all quarters, with the exception of Japan, and there has been keen competition for all available supplies. The nearest values for early delivery are now £15 12s. 6d. per ton f.o.b. Hull, £15 15s. f.o.b. Liverpool, and £15 17s. 6d. f.o.b. Leith. For future delivery higher figures have also been paid, and transactions have been reported at the principal ports at £15 17s. 6d. per ton for January-March, and £15 15s. January-June.

Nitrate of Soda.

There is no change in the spot value of this article, and holders are firm at 14s. 4½d. per cwt. for ordinary, and 15s. 4½d. for refined quality.

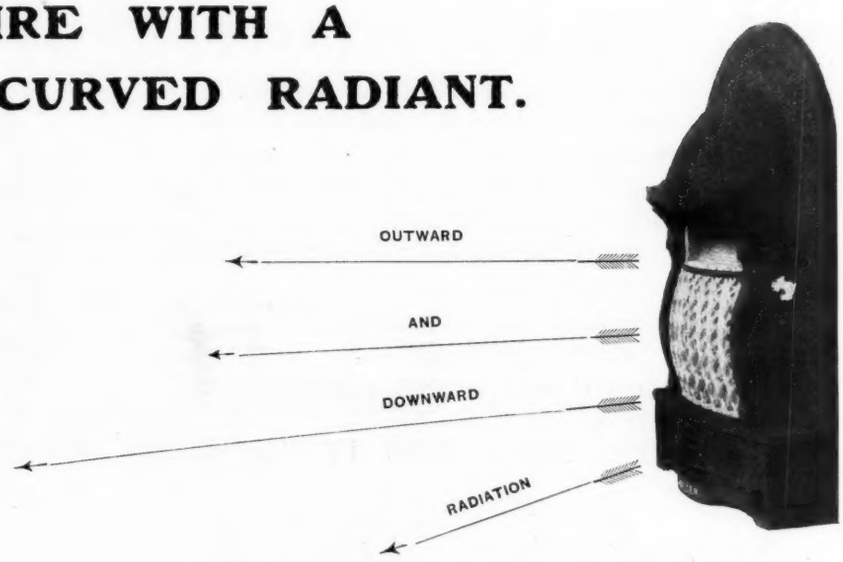
Sulphate of Ammonia.

From another source, it is stated that there has been considerable activity in the market for this article during the past week. Outside London, makes are quoted at £14 10s.; Hull, £15 5s. to £15 7s. 6d.; Liverpool, £15 7s. 6d. to £15 10s.; Leith, £15 10s. to £15 12s. 6d.; Middlesbrough, £15 7s. 6d. to £15 10s.

Meter Inspectors' Wages at Rochdale.—About a fortnight ago, a Special Sub-Committee of the Rochdale Gas Committee reported on the application of the meter inspectors for a revision of wages, and for ten days' holiday with pay in addition to the short Christmas, Easter, and Whitsuntide stoppages. Hitherto it had been the custom for the inspectors to book their overtime, and, instead of drawing pay for it in money, to have its equivalent in time off at slack periods. Accumulated arrears of this overtime had in some cases represented, if calculated on the money value of the time, a substantial sum. The Gas Committee, however, decided to abolish this custom, and to pay for overtime worked at the usual rate of about 8d. an hour. They also decided [in view of a previous resolution of the Town Council on the question of holidays with pay] that they were unable to grant the ten days' holiday with pay which the men asked for. At last week's meeting of the Gas Committee, a letter was read from the Gas-Workers' Union, on behalf of the meter inspectors, asking for fewer hours and holidays with pay; but the Committee decided that they could not go beyond their previous decision to pay for all overtime at extra rates.

An Obvious Advance.

A FIRE WITH A CURVED RADIANT.



A Maximum of PURE RADIANT HEAT.

The "LANCET" says "This fire showed no escape of combustion products into the room whatever."

The "LANCET," June 12th, 1915.

MANUFACTURERS:

THE VULCAN STOVE CO., Ltd. **EXETER.**

COAL TRADE REPORT.

Northern Coal Trade.

The coal trade of the North is easier, chiefly owing to the scarcity of steamers; so that when these are available, prices slightly below those current may be taken at times. Coal is well sold forward; but where tonnage does not duly arrive, collieries are hard put to for full working. In the steam coal trade, best Northumbrians are from 19s. 6d. per ton f.o.b.; second-class steams are 17s. to 17s. 6d. per ton; and steam smalls are 11s. to 13s. per ton—the latter class being rather plentiful. Production at the pits is fairly good, though it will be remembered that the export of coals to some of the northern countries must now begin to show the usual decrease at this season. In the gas coal trade, the shipments are heavier, both for home and to the allied countries. Best Durham gas coals are 19s. 6d. per ton f.o.b.; and for second-class gas coals, 16s. 6d. to 17s. per ton is quoted. "Wear Specials" are steady at 20s. to 20s. 6d. per ton f.o.b. Deliveries of gas coals are good, except where steamers' arrivals are slow; but there is now a general shipment of coals from the Tyne equal to that of a year ago. The rates of freight are very firm—gas coal, Tyne to London, being about 10s. 6d., with record charges to some of the Mediterranean ports. Even at the highest freights for many years vessels are scarce. Coke is, however, being more freely shipped, and is very firm. Good gas coke is from 27s. 6d. to 30s. per ton f.o.b. in the Tyne. From that river the shipments of coke in the first nine months of this year are in excess of those for the same period of last year.

Sale of Gas Shares.—From £6 7s. 6d. to £6 2s. 6d. per share was realized at a local auction sale last Thursday of 75 shares of £5 each, fully paid-up, in the Harwich Gas and Coke Company, upon which the maximum dividend of 7 per cent. has been regularly paid for the last ten years.

Athy Lighting Problem.—It will be remembered that a few weeks ago the Athy (co. Kildare) Urban District Council, disapproving of the Gas Company's action in raising the price of gas, owing to war conditions, decided that the public lamps in the town should remain unlighted. At a special meeting last week, the Council resolved on procuring oil-lamps for public lighting, "pending the introduction of electric or other plant to compete with the Gas Company."

South Metropolitan Gas Company's War Bonus.—A notice was issued to the employees last month stating that the Directors had decided to again follow the precedent set by His Majesty's Government in the case of the railways, and to increase the war bonus to 5s. weekly for all men above the age of eighteen years, and to 2s. 6d. weekly for those below that age. This will be continued until six months after the declaration of peace. During this period, no applications for increases beyond the present current rates of wages will be considered. The first payment of the revised bonus was in respect of the week ending Oct. 21.

Retford Gas and Water Undertakings.

The annual report of the Retford Corporation Gas-Works shows that there now remains only £16,431 13s. 6d. unpaid of the £28,000 loan. There was expended during last year upon capital account £517 on new buildings, mains, and services. The total capital expended on the undertaking is now £56,733, and an over-expenditure of £234. There is a credit balance of £8139; and it is recommended that the sum of £2500 be transferred from the credit balance of the profit and loss account, which now stands at £8139. The revenue account shows that the amount received from the sale of gas and stove-rents was £9634, compared with £9546 the previous year—an increase of £89. Residuals have realized £3566, as compared with £4047—a decrease of £480, owing to the lower market price. The gross profits for the year are £2262, compared with £2422 the previous year. The reduced profit is more than accounted for by the increased price of coal, which amounted to £890 over the previous year. The sum of £500 has been paid out of the profits to the relief of the general district rate. The annual report of the water undertaking shows the principal repaid on account of loans during the year was £328. The whole of the loans raised have now been repaid; and the water undertaking is free from all debts and liabilities. There has been expended during the year on capital account the sum of £2627; the chief item of expenditure being £2495 for the purchase of 21 acres of land, and the balance on the extension of the mains to Welham. There is now over-expended on this account the sum of £2378; and it is proposed to transfer from the net revenue account a sum of £2300 to practically cover this over-expenditure. The revenue account shows an income for the year from water-rates and other charges of £3140, as compared with £3265 for the previous year—a decrease of £125. The working expenses and charges against revenue amount to £1841, as compared with £1926; and after paying the usual instalments and interest on the loans, there is a net profit of £793. Both reports are regarded as highly satisfactory, and as reflecting great credit on the Engineer and Manager (Mr. J. B. Fenwick).

Newmarket Public Lighting Charge.—The Newmarket Urban District Council are still dissatisfied with the proposals of the Gas Company, in the matter of a rebate for gas unconsumed in the public lamps. At their last meeting, they considered a letter from Mr. J. H. Troughton, the Manager to the Company, stating that his Directors, though they considered their previous offer to allow £100 a fair one, would agree to grant a rebate of £150 on last year's lighting contract, in respect of gas unconsumed. This would mean dividing the loss equally. They also submitted that under their sliding-scale four-fifths of any loss the Company incurred would fall on the consumers, who were to a large extent the poorer ratepayers; and it would be more equitable for any loss to be borne by the ratepayers as a whole. Mr. Potts moved that the Council adhere to the first offer made by them, to accept a rebate of £200; and this was carried unanimously.

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Oldbury Gas-Works and Enlistment.

At a meeting of the Oldbury District Council on Friday, the Gas Committee asked to be granted freedom of action in dealing with applications for allowances from men enlisting. Mr. Jackson (the Chairman of the Gas Committee) said if they granted the same allowances to their employees as the other Committees, it would cost them £600 a year beyond what they were now paying: and he was afraid they would have to further advance the price of gas, unless they were allowed freedom of action in the matter. Mr. G. Robbins said he would rather the price of gas go up than the Gas Committee should exploit their employees by refusing to give them any war allowances upon enlistment. Mr. H. Robbins remarked that by such action as was proposed they would, he was afraid, check enlistment. Mr. Green said if they had to make up the wages of men who enlisted from the works, sometimes the Gas Committee would have to pay 1s. or 1s. 6d., and in other cases as much as 17s. or 18s. a week. Ultimately the report was adopted; the Gas Committee being given freedom of action in regard to men enlisting. The Chairman said each case would be dealt with on its merits, and necessary allowances made.

Inefficient Lamplighters and Increased Mantle Consumption.—At the monthly meeting of the Horwich District Council, on the street lighting question being discussed, the Surveyor reported that he was experiencing considerable difficulty in getting suitable men for lamp lighting. Men took on the work, and gave up after one night. The mantle consumption had been very heavy, owing to the inefficiency of the lamplighters and carelessness in lighting. It was decided to continue the lighting of 287 of the lamps, or less than one-half.

Purchase of the Radcliffe and Pilkington Gas Company Advocated.—In the printed minutes of the Radcliffe (Lancs.) District Council there recently appeared a paragraph stating that the Finance Committee had decided not to send representatives to a conference to discuss the price of gas in Radcliffe, Whitefield, and Prestwich, on the ground that no useful purpose would be served by raising the subject at the present time. Mr. Chatterton recommended the three authorities to consider the question of purchasing the Radcliffe and Pilkington Gas Company's undertaking.

Toluol Treatment at Higginshaw (Oldham).—Mr. Arthur Andrew, the General Manager of the Oldham Corporation Gas Department, announced at the last meeting of the Committee that a letter had been received from the Ministry of Munitions expressing satisfaction that the treated tar of the Higginshaw works contained a very valuable percentage of toluol; and it was assumed that the toluol from the whole make of tar at the various Oldham Corporation Gas-Works would be in proportion. Alderman H. Wilde (the Chairman of the Gas Committee) said it was very satisfactory indeed to receive such a letter.

Fatality at Nelson.—A man named Edgar, employed as a labourer at the Nelson Corporation Gas-Works, was missed on Friday afternoon, and on a search being made his shovel was found near one of the coke-hoppers. Subsequently the body was discovered in the hopper completely engulfed in the coke. It was part of his duties to attend to the carts as they came in, and shovel the coke into an elevator, which carried it to the hopper, from which the carts are filled. The hopper contained small coke; and it is assumed that for some reason or other deceased climbed on to the top of the coke, and that it gave way beneath his weight.

Southport Coal and Coke Prices.—In connection with the Board of Trade's circular respecting the limitation of profits in the sale of household coal, the Southport Gas Committee have appointed a Sub-Committee to deal with the matter. In regard to this recommendation, the Southport Trades and Labour Council, at their meeting last Thursday, referred to the "inconsistency" of the Committee in such action, when "at the same time they themselves were deciding to put up the price of coke." Mr. Howson said the price had gone up because of the big demand, while Mr. Southworth remarked that he honestly belived the Committee could sell coke to the poorer people of Southport at 4d. per cwt. He considered 10d. per cwt. an absolute disgrace. It was decided to send a protest to the Gas Committee.

Proposed Labour Board at Birmingham.—The General Purposes Committee of the Birmingham City Council recommend the appointment of a Labour Board to deal with Corporation labour questions as they arise. Last July, the Council directed the Committee to consider the desirability of setting up such a body, to be given authority to determine the question of wages of workmen employed, conditions of their employment, and their transference from one department to another. The suggested Board will take the place of the Joint Committee on Labour which was formed a few years ago; and while it will act as a court of appeal in disputes between the Corporation Committees and their employees, it will not take away from the Committees the right of settling with their employees the rates of wages to be paid.

Gas Workers and War Badges.—In the course of a special meeting of the Stafford Town Council, held to consider the circular-letter addressed to local authorities by the President of the Local Government Board with regard to the establishment of local tribunals in connection with recruiting, a letter was read from Mr. T. H. Tunnicliffe, a member of the Executive of the Trades Council, concerning the wearing of war service badges by clerks and others of the Gas and Electricity Departments. The writer stated that it was ridiculous to say these men were on munitions simply because the works were producing a small quantity of chemicals. The Corporation ought to set an example to other employers by encouraging those of their staff who were fit to enlist. Alderman Westhead (the Chairman of the Committee) said it was not only a question of the chemicals being extracted for the Government, but the production of gas for the manufacture of munitions. The Chief Clerk was the only person in the office wearing a war badge; and undoubtedly his services were indispensable. Some 80 per cent. of the staff had actually joined the Army, including 60 per cent. of the fitters. The Mayor remarked that no doubt a good many were wearing badges who ought not to. He suggested that, in view of the altered circumstances, it should be considered whether it was desirable that all the men should retain badges.

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GAS COMPANIES IN THE STOCK EXCHANGE.

Again the weekly chronicle of Capel Court is a bright one. The Stock Exchange re-opened on Tuesday—after its annual close-day on Nov. 1—overflowing with accumulated animation, and a determination to look at things with a cheerful eye. The favourable factor of recent weeks continued in full force. The great revival in the Western Hemisphere, with a wealth of harvest in Canada, prosperity in the States, gathering strength in Argentina and Peru, and other points more or less notorious now, exercised a potent influence over the markets of the world. It is to be hoped that the upper pressure will not be overdone. Already, indeed, considerable profit-snatching in Americans and Canadian Pacifics has administered a warning. But a welcome recovery was apparent in our Home Rails after their persistent depression, and buyers would have taken much more stock had it been forthcoming. In Government securities, the War Loan was firm, and Colonial issues improved before the close. Japanese and Brazilian were strong. A Japanese loan to France was among the possibilities discussed. The South African Market showed firmness, and several members of the Miscellaneous group advanced—among which were rubbers and oils, and especially shipping. Returns from motor companies and other undertakings engaged in the output of war-like plant continue to show big war profits. Thus prices during the week have risen appreciably, save as stated above in regard to realizations; and there is little doubt that they would have gone higher if there were more of public confidence in our Home Government. The new regulations as to marking bargains came into operation on Tuesday. Business in the Gas Market was not able to maintain the degree of activity attained the previous week, and prices did not seem disposed to advance. The Monte Video Company will pay a 6s. interim dividend on Dec. 1. In the Money Market, rates varied almost from day to day. The rates fixed for new Treasury Bills created a good demand.

Bargains done for cash during the week were as follows: On Tuesday, British 35⅝. Gas Light ordinary 76, 77, ditto debenture 62½, Imperial Continental 63½, Oriental 98, Primitiva preference 3⅜, Tottenham "B" 101½, Wandsworth "B" 102, ditto Wimbledon 103, 103½. On Wednesday, Continental Union 39¾, 40, Gas Light preference 73, ditto debenture 62½, Imperial Continental 64¾, 65, Primitiva 2 15/16, 2⅜, ditto preference 3 7/16, Southend 5 per cent. 90, 90½, South Metropolitan 76½, 77. On Thursday, Gas Light ordinary 76¾, 77, 77¼, ditto preference 73½, ditto debenture 62½, Imperial Continental 64¾, 65, Tottenham "B" 102. On Friday, Gas Light ordinary 77¼, ditto maximum 59⅝, 60½, 60¼, ditto debenture 63, Imperial Continental 64¼, 64⅞, 65, 65¼, South Metropolitan 76½, 77. On Saturday, Gas Light ordinary 76½, maximum 59⅝, 60¼, Monte Video 9⅜, 9¾, South Metropolitan 75½, 76, 76½.

The Bank rate is 5 per cent.—as fixed on Aug. 8, 1914.

As from the 1st inst., the address of the Coal and Coke Exports Committee will be Broadway House, Tothill Street, Westminster, S.W.

Through an electric cable fusing at the Grove Road Military Hospital, Richmond, one nurse received burns, and another was incapacitated by shock.

Co-Partnership at Croydon.

The Co-Partnership Committee of the Croydon Gas Company, in the course of their report for the year ended March 31, state that the bonus is at an average rate of 5½ per cent. for the year; the increase of 1d. in the price of gas from Oct. 1, 1914, involving a reduction of 1 per cent. in the rate of bonus. As a consequence of the further advance of 3d. in the price from April 1, owing to expenses caused to the Company through dear coal and other circumstances arising out of the war, the current bonus is at the rate of 2¾ per cent. The Committee feel sure co-partners will realize that this is inevitable for the present, and will be at one with Directors and officers in the hope that circumstances may soon admit of a return to a more satisfactory state of affairs, and in the resolve that all will do what they can to ensure that the Company may be able to reduce the price again as early as possible. Up to March 31 last, from the inception of the scheme, 887 co-partnership agreements have been entered into, and 241 have terminated; leaving 646 agreements in force. Of the 646 co-partners, 156 are now serving in H.M. forces; but the Directors have decided that the bonus shall be continued to be credited to the accounts as if they were still working for the Company. They are also relieved during their period of war service from payment of subscriptions to which they would be ordinarily liable to the superannuation funds or the workmen's sick and burial fund, though their membership of these, with the benefits accruing therefrom, is unaffected. During the year, £1879 was invested by co-partners through the scheme in stock of the Company, making a total to date of £10,582. The number of co-partners who are also stockholders is now 463. The Committee are glad to be able again to congratulate the co-partners on the facts that the savings (for the 6¼ years the scheme has been in operation) amount to 48 per cent. of the total credited as bonus, and that (apart from withdrawals arising from co-partners leaving the Company's service) only £4046 has been withdrawn out of a total of £12,601 available for this purpose.

Limerick Gas-Workers' Strike Settled.—The Limerick Gas-Works employees went out on strike recently; a demand by them for 3s. per week increase of wages having been refused. The following day, however, on the mediation of the Mayor, it was agreed there should be an increase of 2s. per week; and the men then returned to work.

Developments at Ashton-under-Lyne.—The Ashton-under-Lyne Gas Company are developing the Park Bridge district within their area. It is at present only a small place; but there are cotton-mills and iron-works in the immediate vicinity, and the prospective outlook is good. For the present, gas is to be supplied in bulk through a station-meter; and it is calculated that the Park Bridge consumption during the first year will be about 4½ million cubic feet.

Clitheroe Gas-Works Profit.—In his annual statement relative to the finances of Clitheroe, the Borough Treasurer (Mr. J. H. Taylor) states that the gas-works, which was the only profit-producing department, earned a net profit of £649; the manufacture of the gas costing £8132, of which £6087 was spent in coal. The department paid, during the twelve months, a sum of £212 to the dependants of employees serving in the army. The total expenditure was £10,399. The maintenance of the water-works cost £1106; the income being £4543, of which £2756 was devoted to redeeming annuities, payment of interest on loans, and contributions to the sinking fund.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

ASSISTANT ENGINEER. Australian Gaslight Company. Applications by Nov. 20 to William Coward and Co., Limited, London.
ASSISTANT CHEMIST (OIL REFINERY). No. 6115.
ASSISTANT (Montevideo Gas Company). Applications by Nov. 13.
DISTRICT INSPECTOR. Alliance and Dublin Consumers' Gas Company. Applications by Nov. 15.
ASSISTANT DRAUGHTSMAN. Birmingham Gas Department. Applications by Nov. 15.
FOREMAN FITTER. Birmingham Gas Department. Applications by Nov. 15.
FITTER. No. 6116.

Plant, &c., Wanted.

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See Illustrated Advertisement, Aug. 24, p. 421.

GAS-WORKS requiring Extensions should Communicate with FIRTH BLAKELEY, SONS, AND CO., LIMITED, Dewsbury, who make a Speciality of Catering for the Smaller Gas Concerns. Prices Reasonable; quality and results, the best. Satisfaction Guaranteed.

SULPHATE OF AMMONIA SATURATORS and all LEAD and TIMBER WORK in Connection with Sulphate Plants.
We Guarantee promptness with efficiency for Repairs.
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PATENTS AND TRADE MARKS PUBLICATIONS: "MERCHANDISE MARKS ACT, and Decisions thereunder," 1s.; "TRADE SECRETS v. PATENTS," 6d.; "DOCTRINE of EQUIVALENTS, Mechanical and Chemical," 6d.; "SUBJECT-MATTER of PATENTS," 6d.
MEWBURN, ELLIS & PRYOR, Chartered Patent Agents, 70 & 72, Chancery Lane, London, W.C. Telegrams: "Patent London." Telephone: No. 243 Holborn.

GAS PLANT for Sale—We can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.
FIRTH BLAKELEY, SONS, AND COMPANY, LIMITED, Church Fenton, near LEEDS.

TAR WANTED.

THE Burnden Tar Company (Bolton), Ld.
HULTON CHEMICAL WORKS, BOLTON.

"GAZINE" (Registered in England and Abroad). A radical Solvent and Preventative of Naphthalene Deposits, and for the Automatic Cleaning of Mains and Services.
It is also used for the Enrichment of Gas.
Manufactured and Supplied by C. BOURNE, West Moor Chemical Works, KILLINGWORTH, or through his Agents, F. J. NICOL & Co., Pilgrim House, NEWCASTLE-ON-TYNE.
Telegrams: "DORIC," Newcastle-on-Tyne. National Telephone No. 2497.

J. E. C. LORD, Ship Canal Tar-Works, Weaste, Manchester. Pitch, Creosote, Benzols, Toluol, Naphtha, Pyridine, all kinds of Cresylic Acid, Carbolic Acid, Sulphate of Ammonia, &c.

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JAMES MILNE AND SON, LIMITED.

THE AUSTRALIAN GASLIGHT COMPANY,
Sydney, by their London Agents,
WILLIAM COWARD & CO., LTD.,

INVITE Applications for the Appoint- ment of an ASSISTANT ENGINEER.
Salary, £600 per Annum.
Candidates must state Age, Educational, Technical, and Commercial Knowledge. Those who have had Experience in handling Workmen and the Glover-West System of Vertical Retorts preferred.
Copies of such Testimonials as may be considered necessary to be enclosed.
Applications, endorsed "Engineer," must be received by the 20th of November; the Appointment to be taken up in the early Spring.
100, Bishopsgate, London, E.C.

THE Directors of the Montevideo Gas Company, Limited, require the services of a Well-Trained and Qualified ASSISTANT to the General Manager in Montevideo.
Particulars as to the Terms of the Engagement can be obtained from the undersigned.
Applications, stating Age, Salary required, whether Married or Single, Qualifications, and Experience, both Technical and Commercial, with *copies* of not more than Two recent Testimonials, to be made not later than Nov. 13.

By order,
HENRY KEARNS,
Secretary.

Offices of the Company, 321, Dashwood House, New Broad Street, E.C., Oct. 23, 1915.

ALLIANCE AND DUBLIN CONSUMERS' GAS COMPANY.

APPLICATIONS are invited for the Position of DISTRICT INSPECTOR to the above Company.
Candidates when applying must state previous Experience in Salesmanship of Cookers, Fires, Radiators, Water Heaters, &c., together with General Experience of Canvassing and District Work.
Applications, stating Age and Salary required, accompanied by *copies* of recent Testimonials, must reach this office on or before Monday, the 15th of November, 1915, endorsed "District Inspector," and addressed to
W. J. GREY,
Secretary and Accountant.
24A, D'Olier Street, Dublin.

ASSISTANT Chemist required for Oil Refinery in South of England. Experience in Distillation, Refining, and Testing of Mineral Oils necessary.
Apply, by letter in first instance, stating full Particulars, Experience, Age, and Salary required, to No. 6115, care of Mr. KING, 11, Bolt Court, FLEET STREET, E.C.

CITY OF BIRMINGHAM.
(GAS DEPARTMENT.)

APPLICATIONS are invited for the post of ASSISTANT DRAUGHTSMAN at the Nechells Works. Candidates should have had some Experience in a Contractors' Office and must be well acquainted with the Design and Construction of Gas-Works Plant.

A FOREMAN FITTER is also required for the same Works. Preference will be given to a Man with Experience of Stoking Machinery and Water-Gas Plants. Must be able to Control men.
Candidates must state their Age, Salary required, and give full Particulars of their Experience and Training.
Applications, addressed to the Engineer, Nechells Gas-Works, Birmingham, should be received not later than Monday, Nov. 15 next.

WORKS Fitter required by Gas Com- pany in the South of England. Must be capable of Repairing Gas and Steam Engines, Coal Conveyors, &c.
Apply, by letter, stating Age, Experience, and Wages required, to No. 6116, care of Mr. KING, 11, Bolt Court, FLEET STREET, E.C.

WANTED—Good, Clean, and Hard CARBON, in Four-Ton Lots, or more, f.o.r.
Address, No. 6072, care of Mr. KING, 11, Bolt Court, FLEET STREET, E.C.

TANK Waggons Wanted for Hire or Purchase about the middle of January next, in connection with Munition Work.
Address, giving full Particulars, to No. 6113, care of Mr. KING, 11, Bolt Court, FLEET STREET, E.C.

FOR SALE—Producer Gas Plant, con- sisting of PRODUCERS (2), WASHERS (2), PURIFIERS (4), and GASHOLDER of 2000 cubic feet. Capacity, 100 H.P. Makers, Power Gas Corporation, Limited, in 1907. Condition good.
The Plant may be seen, and Form of Tender obtained, on Application to the SUPERINTENDENT, Royal Gunpowder and Small Arms Factories, ENFIELD LOCK.

LATEST Model Remington No. 10 TYPEWRITER, Visible, Two Colours, Backspace, Tabulator, and all Attachments. Cost £22 10s. Absolutely unsoiled, £12 10s. Also Remington No. 7, just been overhauled, £5 15s., or near offer. Cash wanted. Free trial willingly. Will guarantee.
WALTER WHITE, Arcade Chambers, NORTHAMPTON.

STORAGE TANKS.—Various Capa- cities. CAST IRON and BOILER TANKS. STEEL TANK about 280 Tons Capacity. Immediate Delivery.
FIRTH BLAKELEY, SONS, AND CO., LTD., CHURCH FENTON, LEEDS.

GAS PLANT of every Description Wanted. Best Prices Given and Prompt Removal. Specialists in Gas-Works Dismantling.
FIRTH BLAKELEY, SONS, AND CO., LTD., CHURCH FENTON, LEEDS.

LIVERPOOL GAS COMPANY.

TENDERS FOR CANNEL.

THE Directors of the Liverpool Gas Company are prepared to receive TENDERS for the Supply of 30,000 Tons of CANNEL, to be Delivered at the Linacre Works of the Company during the period of Twelve Months between the 1st of July, 1916, and the 30th of June, 1917.
Tenders will be received for the whole or any portion of the above quantity.
The Directors reserve the right to accept Tenders for the whole or any portion of the quantity offered, and do not bind themselves to accept the lowest or any Tender.
Full Particulars and printed Forms of Tender can be obtained on Application to the undersigned, at the Gas Office, Duke Street, Liverpool.
Sealed Tenders (on the printed form only), addressed to the Chairman of the Company, must be Delivered at or before 10 a.m. on Wednesday, the 17th of November, 1915, endorsed "Tender for Cannel."

R. E. GIBSON,
Engineer.

Gas Office, Duke Street, Liverpool.